Member of Associated Business Papers, Inc.

Member of Society for Electrical Development, Inc. *Member of Audit Bureau of Circulations*

Electrical Review

and WESTERN ELECTRICIAN with which is consolidated ELECTROCRAFT

Vol. 70—No. 21. CHICAGO, SATURDAY, MAY 26, 1917. PAGE 861.

THE ELECTRICAL INDUSTRY AND THE WAR

THIS country has been let into the war by such easy stages, the possibilities of invasion seem so far away, and even the extent to which the service of a million fighting men will affect our population will be in such an easy assimilable way that it is difficult, indeed, for us to realize that we are actually engaged in the most terrible war that has ever been visited upon mankind.

In a way, it is perhaps fortunate that such is the case. Mixed as we are in racial proportions, loving pyrotechnics and embracing every opportunity for display of enthusiasm, it is well that some means of curbing the tendency toward hysteria is available. Even with the lack of exciting causes that we witness every day some well intentioned set of people follow hysterically after some wild idea and it is a relief that the dangers are far enough removed to allow sufficient time to elapse for calmer councils to prevail.

For some considerable period after war was declared our allies found it difficult to co-ordinate administrative affairs and manufacturing conditions so as to serve the needs of the nation with the greatest efficiency. This was due to the natural apathy and bewilderment which affects most people in a crisis of any kind. The nation in mass is but a composite of the individual, and until clear-headed and logical thinking leaders arrive out of the mental turmoil, there is little done to steer the course of human events the way in which the working of tremendous forces will have them go. Fortunately for us, we have had access to the counsel and advice of those who have been through all of this turmoil, and many of the mistakes and a good deal of the muddling can be avoided.

What we must realize first of all is that the nation is really at war. It is not a matter of sentiment, of bluff or of conversational participation. This country has entered the war because of dire necessity upon the part of the allies for the assistance which only this country could give to them. The nation is at war and will be at war for some considerable period.

With the great prosperity which has preceded the participation of this country in the conflict, and with the splendid physical condition of all of our equipment factors, the task of mobilizing our industries to take care of the situation, while a tremendous problem, is one that need give the country no pause. For over two years our factories have been making ready to turn out supplies under emergency conditions, we have been gathering raw material from all corners of the earth, and as a people we are prepared to make those sacrifices and to establish those methods of living that will best conform to the conditions to be met. While only a few weeks ago there was rampant a desire to economize in every

direction, already there is a better understanding of the things which are to be done, and there is now little fear that we will go to the extreme and establish an hysterical form of thrift that would defeat the very purposes of a people under a great necessity for keeping things as nearly as possible upon a normal basis.

A survey of conditions in the electrical industry finds us well prepared. It is a fact that in every great crisis the electrical industry has apparently been the most easily adapted to meet changing conditions of any magnitude. That there will be changes there can be little doubt, but so great are our resources that even in large centers of population where in addition to a tremendous domestic load there is a power demand of great proportions and consequently the connected load bears a very high ratio to station capacity, the excellent control of the diversity and the adaptability of load dispatching will make it possible for our managers of electric light and power companies to meet every emergency.

Similarly the conditions to be met with regard to employees of light and power companies and of our manufacturers who will be called to the colors will be worked out and adjustments made so that the burden may be divided as equitably as possible among those who will remain in employment and those who will respond to the opportunities for service in the Army and Navy.

The electrical industry will be vitally affected in three important relations, namely, its ability to finance necessary developments, its ability to keep up with demands for material of every description and its ability to respond to changes in load-factor, increased demand for electrical energy and adaptability in adjusting its trained forces to carry the load and substitute men for those called to the colors.

As is pointed out on other pages of this issue, during the first flush of patriotic enthusiasm upon the part of our allies, large numbers of employees of electric light and power companies and of electrical manufacturing concerns and electrical engineers and executives of these organizations responded to the call so that shortly after the beginning of war's real activities the shortage of these most necessary elements in maintaining manufacturing and engineering efficiency for the production of everything needed for the prosecution of the war was severely felt. It was necessary to recall men from the front in order to properly man power stations and factories devoted to the manufacture of munitions of every description. With true patriotic impulse, also, the proprietors of these concerns guaranteed not only to support the families of the men at the front, but volunteered to keep open their places of employment and restore the men called away to their positions at the end of the period of war. Under the actualities as they have developed it has been discovered that many conditions which looked easy of fulfillment at the beginning of the war now appear to be highly impracticable.

With full knowledge of all of the conditions to be met it is hardly likely that the same mistakes will be made. So far as financing is concerned, administration officials are already arranging that the tremendous amount of money to be raised for the prosecution of the war shall affect our liquid banking assets to as slight a degree as possible so that money necessary for the developments of our utilities shall be available upon reasonable terms. The absorbing power of the great mass of the American people will, to a large extent, take care of the floatation of the war bonds and leave available for the purchase of bonds and securities of utility corporations those funds which are ordinarily represented in transactions of this character. In like fashion in making up lists for the calling of men to the colors some such plan as has been adopted abroad will be put into effect so that the forces of skilled employees whose services are necessary in our power stations and electrical manufacturing companies will not be greatly curtailed.

Above all, the present situation calls for calm judgment and abiding faith in the stability of the country and its institutions, and a determination not to be led astray by immediate fears for the situation. It is to be noted with regret that the Iowa State Electrical Association has cancelled arrangements for its convention. While it is quite likely that men will not want to devote much time away from their business headquarters, it seems that this is the time more than ever before to take a few days for earnest discussion of the problems to be met and the interchange of views as to the best way of solving each difficult situation. It was indeed the part of wisdom to change the plans for the convention of the National Electric Light Association, where men would have been drawn for a period of a week from all parts of the country, but where men can get together quickly as in state conventions the opportunity should be taken advantage of and at the earliest possible moment. In passing we might add that we heartily approve of the abandonment of the exhibit in connection with the National meeting, as this would have tied up thousands of tons of valuable material for exhibition purposes which should be made available wherever the emergency exists for the utilization of this equipment.

Upon other pages of this issue we are pleased to present a series of articles detailing in authentic fashion with the way in which England, France and Canada mobilized their electrical industries for war. The article dealing with the situation in Great Britain has been prepared after a careful study of conditions, with a supplementary comment by Albert H. Bridge, our British correspondent. The article dealing with Canadian conditions has been prepared by Gordon Keith, of Toronto, Canada, a close observer of electrical affairs in the Dominion, and the article dealing with conditions in France has been prepared by Mons. J. Blondin, technical director of our esteemed contemporary, *La Revue Generale de Electricite.*

Electrical Mobilization in Great Britain

How Manufacturers and Utility Companies Met the Unusual Conditions Imposed by War

By F. T. BANGS

TRACING the effects on the British electrical industry caused by the hostilities between the great European nations leads one into a maze of statements and reports—all, we know, tempered by censorship—from which it is impossible to issue without the conclusion that only the fragments of the actualities have been recorded. Some of the early conditions now stand revealed, since the knowledge of them can no longer have any bearing on the conduct and outcome of the war, and it is therefore possible to draw conclusions that point out what to do and what not to do for any other nation entering the conflict. One of the hardest lessons learned, it appears, has been to dissolve an apathy and bewilderment regarding what to expect and prepare for into a clearness of vision that recognizes that the thing to do is to organize trade and industry, as well as war movements and every other human activity, into a state of preparedness that can effectively meet any exigencies that may arise. The doctrine of preparedness—or, better still, of organization for preparedness—has had its foundation laid in the very roots of human experience during the last three years.

A retrospect of the mobilization of the British electrical industry involves the thumbing over of many pages of mother-country publications, as well as putting one's ear to the ground in the attempt to find out how it has been worked out. It would be easy to record the processes of this mobilization if they occurred within a few weeks or months after the outbreak of the war; as it is, it is difficult because the training of the different factors of the British electrical industry into war-making channels has occupied the entire period of the war and is necessarily continuing at the present time.

Obeying the Call to Arms.

The first flourish of the war struck its note in the patriotic impulse to respond to the colors—to obey the national call for a union of all forces in the Empire in defense of common interests. The loyalty of the electrical fraternity cannot be questioned. Many of the industrial firms reported an enlistment of five to ten per cent of their men during the first week of the war. Another indication is given in the hastened step of the Institution of Electrical Engineers to make up a register of its members willing to place their services at the disposal of the government, and also in placing at the disposal of the War Office portions of its building as quarters for recruiting purposes. Two years after the beginning of the war the bulk of the 7,000 members of this association were in public service, carrying out the measures of war, while 1,150 were in active service. That is the record of one branch of the industry; those of the other branches will be found as noteworthy. To further the cause many of the electrical firms in their patriotic generosity guaranteed a continuance of salaries (in most cases, full pay to married men and one-half pay to single men) to those in their employ who went to the front.

The next outstanding feature was the effort made to avoid a hurried decision to cease business. The British industries and commerce were subjected to a stress and readjustment entirely unique in the history of the nation. England's relations with its neighbors were so closely interwoven and so intricate that their severance produced untold effects. Reports have indicated that certain industrial circles were on the verge of a panic, resulting in a severe dislocation of trade and a wholesale discharge of employees that threatened dire consequences. The "bugaboo of unemployment" became a severe menace, and those not needed for the service were urged to put forth every effort to maintain the volume of trade and keep the wheels of industry going full speed, and thus secure employment for the bread-winners of the country. It was repeatedly stated at first that there was no cause for uneasiness and that there was no reason to anticipate the interruption of supplies of food or the raw materials of industry. Many British manufacturers, electrical as well as others, accepted orders at usual prices and terms of payment, and declared their intention of continuing to do so until circumstances, which, of course, were not then foreseen, demanded a change. Taking advantage of the moratorium was not condoned, and the slogan of "Business as Usual" was fathered to give a tone of confidence in the markets.

The circulation of money was regarded as the keynote of the situation, as is evidenced by the following from the London *Electrician* two weeks after war had been declared:

"It will be agreed that it is highly desirable that no departure shall be made from the usual practice with regard to credit accounts, unless circumstances arise which render it absolutely unavoidable. And there is no evidence at present that such circumstances will arise. They can only arise through the locking-up of funds, and, if this is kept in circulation, it will be avoided."

There was a tendency on the part of purchasers to take advantage of clauses in their contracts to suspend and delay work on account of the war, which had a derogatory effect on industry in general.

Trade Conditions in the Fall of 1914.

Two months after the beginning of the war the London *Electrical Review* obtained statements regarding the effect of the war upon trade conditions by means of a questionnaire sent to the principal British electrical manufacturers. The essence of the reports was that the volume of orders for goods was satisfactory; that in most instances labor conditions were normal, and in others that skilled labor was hard to obtain, resulting in overtime operations; that there were sufficient raw materials; that financial conditions were satisfactory, and that orders were being accepted freely. It would appear that the full effects of the war had not yet materialized at that time.

These reassuring statements were somewhat modified in the latter part of 1914, for in its review of the year, the same publication stated:

"The declaration of war between Great Britain and Germany exerted a most important influence upon the whole of the industry. Some of the largest works were called upon to devote their whole output to the service of the government, and at the same time the influx of electrical goods from the Continent came almost to a full stop. On the other hand, large numbers of men were called to the colors and many others joined the new army, including a large proportion of skilled men whose services are very largely missed; indeed, it is a question whether the government would not have been well advised to forbid the enlistment of skilled workmen at the start, as it practically did in autnmn, for the manufacture of munitions, motor vehicles, equipment, etc., is of the first importance. Electrical manufacturers thus found their operations severely hampered at a time when an increased output was imperatively called for. However, every effort was made to cope with the exceptional conditions and the steady inflow of raw materials has prevented any difficulties on that score. The general feeling among British manufacturers is one of cheerful optimism."

The review of the London *Electrician*, published at the same time, summed up the situation in a more general way, though it is possible to read much between the lines.

"The crisis came in this country with such extreme suddenness that its effect was greater than would have been the case had there been a more lengthy warning. And apart from its suddenness, its magnitude was quite beyond the ken of those concerned with our industrial affairs, and it became a question of dealing with the crisis without previous experience of a kind to be of any real value. * * * The whole financial working of the British Empire, as well as of the greater portion of the world outside the Empire, was suddenly disorganized and our trade routes threatened or closed. Fortunately, the government acted without delay or indecision, and its action has been such as to enable us to pass successfully through the most severe crisis in the history of the world."

It came to be realized that the campaign for "Business as Usual" was a mistake, that the business at hand was war, and that the policy should have been to prosecute the war to a successful issue without delay.

Factories Turned Into Munition Works.

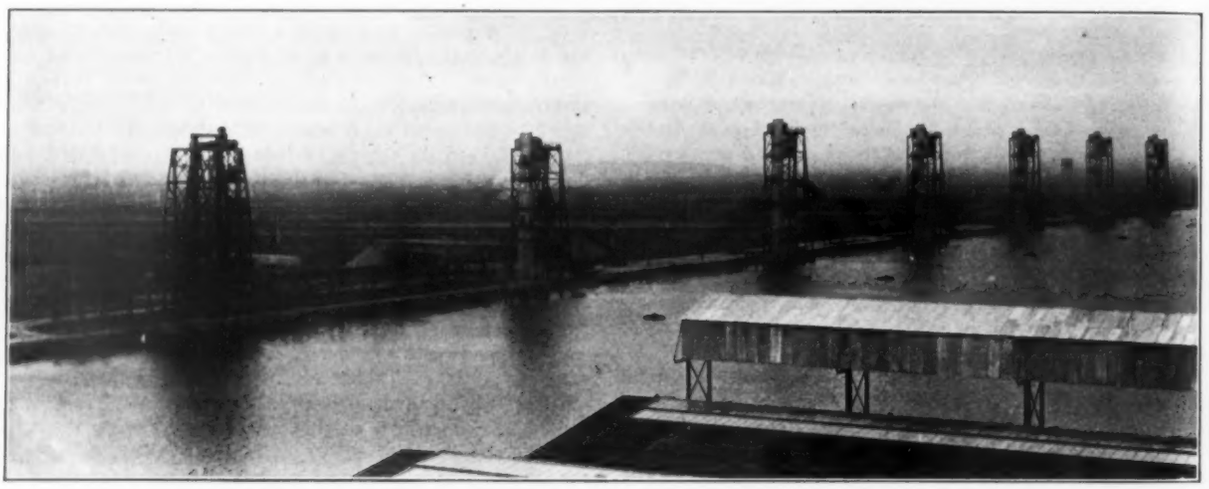
As time went on, it became increasingly necessary for the manufacturing resources of the country to be applied to the production of munitions of war, thus curtailing ambitions for the maintenance, let alone expansion, of export trade. The insistent demands for men for active service and for munition work encroached upon the supply of labor for purely commercial pursuits and relegated the latter to the rear, and, together with the lack of materials, hampered foreign trade operations. Conclusions can be drawn from a report of the directors of the British Westinghouse Electric & Manufacturing Company, which stated that the company had, at the outbreak of the war, on its payrolls, 4,720 men and 513 women, a total of 5,233, and in April, 1916, had 5,504 men and 1,344 women, a total of 6,848. The number joining the Colors had been approximately 2,000.

The calls for men for service at the front and for work in the munition factories were conflicting, and light is thrown upon this condition by the following from the *Electrician* of November 12, 1915:

"In the early days of the war large numbers of recruits for the new armies were drawn from the engineering trades, the pursuit of which is a matter of life and death in time of war. Months afterwards the inevitable shortages made the position clear. Many of these men were sent back as hurriedly as they had been recruited in order to continue the making of munitions. Many months of labor were thus lost, to say nothing of the cost of training the men for military duties."

Effect on Workers in Central Stations.

There appears to have been no restrictions placed upon the enlistment of men employed in the electrical supply undertakings (central stations) until March, 1916, when the Board of Trade, appreciating the significance of maintaining an adequate power supply, especially for munition plants, issued a revised list of reserved occupations in connection with public utiltiy service which included all classes of workmen in electrical generating stations.



View of Seven Electrically Operated Coal Hoists at Immingham Mobilization Dock, Near Hull, England.

The difficulties of these companies is indicated in the yearly report of the Newcastle-upon-Tyne Electric Supply Company, Ltd., made about the same date, in which it was stated that 270 of its employees had gone to war, the vacancies being partly filled by women and partly by discharged service men. As it was necessary that some of these men and women should have a technical knowledge, the company established regular classes for them, where lectures were delivered and demonstrations given by its own officials. The systematic training proved beneficial and the men and women were giving satisfactory results.

Also bearing upon the same subject is the report of a conference some months ago of chief officials of the London companies, at which there was pointed out the danger of too severe cutting down of the staff and employees in electricity works, the necessity for considering the employees in electricity departments from the standpoints of technical capability, experience and physical fitness, the difficulties and dangers and limitations of "substitutions," the employment of disabled soldiers and sailors, and women and girl labor, the shortage of labor in the neighborhood of some large undertakings, the difficulty, and, in some cases, the impossibility of making reductions in the staff of small undertakings.

Likewise, the effect on electrical construction is shown in the following resolution passed by the Liverpool Branch of the Electrical Contractors' Association early in 1915.

"That in the opinion of this meeting it is advisable in the interests of the country that a certain number of women should be trained in various branches of electrical work to ensure that the country's commercial work shall not suffer through the war; and this shall be strictly without prejudice to the electricians who have enlisted for national service, as we believe that in ours, as in other branches of national work, the soldier, after the war is ended, has the first claim upon the nation, but that we are emphatically of the opinion that the work of the country must go on, as without that we cannot beat the enemies."

Mobilization of the Central-Station Industry.

While the dearth of labor affected electricity supply undertakings as greatly as it did the manufacturers, it appears that the mobilization of the former was subsequent to the taking over of the factories into public service, this because munitions production was not at first directly traced to the essential power supply. The increase in the output of war materials emphasized the necessity of more attention to the regulation and fostering of the central-station industry.

The most striking features in connection with the placing of the electricity supply works into public service were the high prices of coal; the lighting restrictions; the Summer Time Act, (Daylight Saving Act), which went into effect May 21, 1916; the Board of Trade order issued in December, 1916, placing restrictions on the use of coal, and the recently expounded desirability of the linking together of generating stations.

Temporary Electric-Driven Hoists for Loading Direct from Railway at Immingham Mobilization Dock.

Notwithstanding adverse conditions, the electricity supply companies have done very well. This fact is brought out in the *Electrician* of February 25, 1916.

"The lighting restrictions, the obstacles to the connection of new customers and the high prices of coal and other materials have adversely affected most electricity supply companies, even those with a large power load. There were reduced net profits and a slight drop in dividends owing to increased cost of coal, higher wages, allowances made to men serving with the Colors, etc. Those companies in the industrial areas experienced a satisfactory year's working."

In its issue of March 2, 1917, the same journal said:

"Considering the high price of coal, the labor and transport difficulties, the business of the majority of the London electrical supply companies is reported to be very satisfactory. Many companies were compelled to raise their charges in order to compensate for the increased costs and diminished consumption, but it is doubtful if the advance balances the adverse factors referred to. Some of the companies, especially those supplying in industrial areas, where the demand for electric power is great, have done better than in 1915, but the record of some of those in residential districts is not so good."

Referring to the question of the interconnection of electricity supply undertakings, the London *Electrical Review* of May 26, 1916, said:

"The importance of this step can hardly be exaggerated, not only its bearing upon the conditions which exist in war time, but also in its effect upon the whole future of electrical engineering in this country. We heartily congratulate the Board of Trade upon its prompt action, and upon the intention, which is plainly manifest, to follow up the policy suggested. * * * To be effective during the war, the policy of interconnection must be put into force at once. The immediate benefits to be derived from this course consist chiefly in economy of fuel and the release of stand-by plant to cope with the increased demand for power."

Review of Conditions During 1916.

A survey of conditions as affecting the electrical industry in England can be gained from the review of the events of 1916 made by the London *Electrical Review* in its issue of January 5, 1917, extracts from which follow:

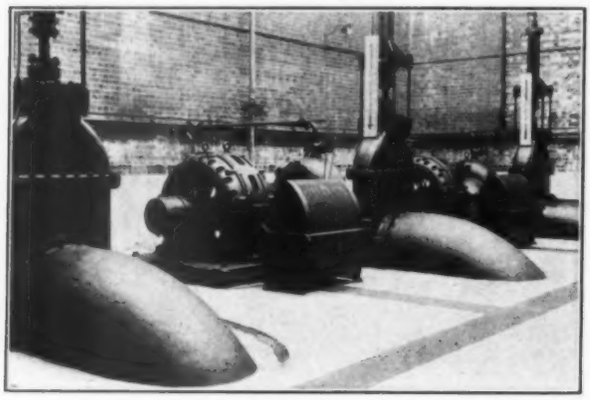
"The manufacture of munitions of war in thousands of works throughout the British Empire has made such demands upon engineering genius and skill as to have demonstrated for all time the essential nature of the engineering profession and industries of the nation. And the part that electricity and its applications have performed in this connection, though only partly known at present, will remain forever a monument in honor of the usefulness of the electrical engineer. * * *

"The year that has gone (1916) has not only been one of continued organization for the purposes of war, for deliberations and investigations have become focused in the committee rooms, where, at the bidding of the government, experts have been inquiring into the details of our great industries and the measures safeguarding their interests after the war. * * * Notwithstanding our preoccupation with actual war work, and with all these efforts at industrial and trade organization, individual manufacturers have been able to lay the foundation for special lines of manufacturing, and, besides meeting the exceptional needs of war, factory installation at home have admirably maintained the value of our electrical and allied exports at a figure which, but for restricted tonnage accommodation, labor and material, would have been mulitiplied several times, so great has been the demand.

"The intense activity of our industries in general has caused the demand for electric power to multiply and increase far beyond even the high record of 1915, and has thus reacted upon the electricity supply industry, which has been hard put to it to keep pace with the growing load. * * * Those undertakings which are situated in manufacturing districts have recorded outputs of energy breaking all records, and in many cases substantial profits have been made; large stations have been hastily extended, and some small stations, which never

anticipated anything in the nature of a power load, have awakened to find themselves equipped with three-phase turbo-alternators, badges, and a 24-hour load. That the war activities of the supply stations will secure for them the confidence of power users and generate a momentum which will ensure to them a permanent and substantial development cannot be doubted.

"The spirit of co-operation for patriotic ends * * * has made itself felt in the electricity supply industry to good



Pump House, Immingham Mobilization Dock, Showing Three Electrically Driven Pumps Capable of Throwing 9,000 Gallons per Minute.

purposes and has brought into existence a movement toward the interconnection of electricity supply undertakings, which was initiated by the Institution of Electrical Engineers * * * and immensely invigorated by the unexpected support of the Board of Trade. * * *

"The spirit of co-operation * * * has extended to government circles also, and we gladly recognize again the striking change of attitude adopted by our rulers towards industry in general. The Committee of the Privy Council, guided by its Advisory Council for Scientific and Industrial Research * * * has recently declared its intention to devote comparatively large sums to the promotion of research and similar purposes, in consultation and collaboration with representative trade associations—a significant indication of the new spirit that sways the government."

What has been given above has been written in this country, and though no apologies are offered for it, except to our British contemporaries for gaining from them much of the information given, nevertheless it must necessarily be tinged with American interpretation and judgment as to the degree of importance of the many events that have had to do with England's mobilization of its electrical industry. At our request, our London correspondent, Albert H. Bridge, has prepared a comprehensive statement on the "Effects of the War to the Electrical Industry," which illuminates in many particulars what we have written in regard to mobilization.

An Englishman's Views on Some of the Electrical Effects of the War.

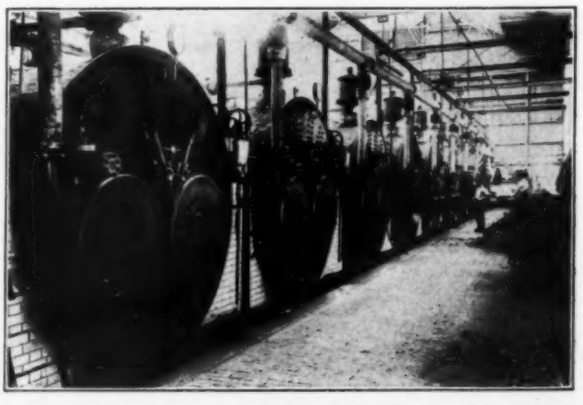
When the world begins to settle down to rest again, one of the most interesting and profitable subjects for study will be the likely permanent effects of the experiences and lessons of war-time upon the habits and customs of the people. Millions of subjects in practically all civilized countries and states have found themselves in situations such as they had never dreamt of, and faced with conditions which nobody could possibly have anticipated and for which therefore few could possibly be prepared. There has been more furious thinking, in these times of emergency, more ingenuity, more adaptability, during these three years of warfare on the sea and under it, on land and in the air, than in any previous period many times as long. It is obvious at once that the theme is a vast one, almost bewildering as one attempts to review the occurrences within one's own limited knowledge. Further, while the war is still blazing away in Europe, and still new emergencies are arising calling for prompt and appropriate measures, it is far too early to attempt to review a hundredth part of the whole floodtide of tendencies that are flowing as the direct and indirect consequences of so violent a shaking of the very foundations of human existence.

The close student of the literature of some of the countries prominently involved must feel that almost as much has been written about "after the war" as about the war itself, and at one stage a certain English politician of note acquired a measure of unpopularity in some circles by protesting "Look after the war and after the war will look after itself!" The objectors were the men who were anxious for a wise policy of "preparedness" to be adopted so that the British nation might not be unready for peace as she was unready in a military sense for war. Yet with all the thinking ahead that has been done, and all the measures that have been proposed or adopted for the future, it is still impossible to pierce the veil and predict with certainty many of the features of the times that are thought now not to be far off.

In a matter of such immense proportions and having a multitude of general possibilities, we are fortunately limited in these pages to only a comparatively few parts of the whole, as these may be regarded as falling within our immediate scope. Specialists alone can review the parts falling within their own particular department, and anybody who thinks for five minutes will admit that the specialized electrical observer who has anything like an intimate acquaintance with the actual effects of war-time conditions upon electrical activity and application, and the part that electricity and electrical science and industry have everywhere filled in close connection with either preparations for war or with the conduct of actual operations, and, better than all, with the humane measures of healing and mending sick and broken soldiers and sailors, must have a wonderful story to tell. Though that story cannot yet be told, we are able to discuss some of the more promising probabilities in a more or less general sort of way.

Electrical Advance Sure to Come.

Whatever there may have been in the shape of temporary disabilities for those eager for electrical advance in some of those directions which held such brilliant prospect before the



Battery of Nine Lancashire Boilers in Power House at Immingham Mobilization Dock.

world went to war, we may confidently say that those disabilities can in the nature of things be but temporary, and when the present braking power has been withdrawn, there will be a leap ahead practically everywhere with all those classes of development that we had come to regard as normal in character. But what is even more unquestionably certain is the great value that must accrue to the world at large from many electrical achievements and ingenuities that have

been brought about as direct consequences of scientific nations being at war with each other.

It is lamentable to think with what prodigality there have fallen out of life, while engaged in actual fighting, young men of proved or potential genius who might have conferred untold benefit upon millions by continuance in the exercise of inventive ingenuity and research. What the world has lost in this way never can be known, of course; and it is useless to deplore it now; some of them entered fired with patriotism before it was evident how scientific and engineering a war it would be. Yet, notwithstanding this lamentable loss, we cannot help recognizing how great has been the effect upon thousands of men of their kind who still continue their work and have labored during these two or three years under the impelling influence of emergency and absolute necessity, calling imperatively for the best that they could give, the best that they could contrive. In such a matter we never shall be able to tell whether our gains have been greater than our losses, but we certainly know that we should have been richer still had statesmen appreciated at an earlier stage the value of the scientific mind.

Status of Science and the Engineer Raised.

Science stands higher now in the councils of the state in many countries than before the war, and she will never be allowed to fall from that more privileged position. That we think may be regarded as one of the "after the war" certainties. The engineer, too, has had his status raised substantially by the part he has played, whether in the field or in munition manufacturing. No state in future will be able to cold-shoulder its engineers, its chemists, its electrical experts; they have proved their value as a veritable national bulwark. What they have done will not only help in the conduct of the war but the application of much that they have done, to the industrial and general life in peace time, will be noted and continued for years to come. Perhaps some of the greatest good that will come to the world in general from the horrors of modern warfare will be the legacy that will reach to suffering humanity in all the years that follow, from the tens of thousands of medical and surgical minds from all the countries that have sought to save life, heal wounds, repair and replace broken limbs. In this connection when all can be told it will be found that the part that electricity has performed forms one of the most fascinating chapters of the war. Experience and discovery in these departments are not limited to soldiers, the civilian benefits too; they are also international.

War Has Popularized Electricity.

If as commercial electrical men we inquire what the probable effects of present experiences will be upon the electrical trade of different countries we find it profitable to investigate the habits and customs of the people and see how they have been and are being affected by the altered conditions which war has imposed, conditions which will not be removed all at once because peace comes, while some of them may last sufficiently long as to be regarded as permanent for our present purposes. All countries have a better appreciation of the value of coal supplies than they had before; wastefulness in this connection is everywhere condemned and whether in industry for power purposes or in the household for domestic heating and cooking the advantage of electricity as a fuel saver has been abundantly demonstrated. The electricity suppliers have reaped the advantage in many cases, though they themselves have had their serious coal-shortage problems, and have learned anew to develop measures of economy in consumption. Electricity supply will not only resume its normal rate of advance for all purposes after the war, but the necessities of war-time have been doing among the public the work that some electrical development committees have had reluctantly to hold in suspense.

Perhaps no simpler or better illustration could be advanced of the popularizing effect of the war upon electricity with the general public, as we call them, than the immense demand that has arisen in England for pocket flash-lamps amongst hundreds of thousands of people who never knew the value of portable electricity until the war imposed an absolute need. In the dark evenings preceding and following the Christmas season of 1916 the demand for devices of this

S. S. "Manchester Civilian" and S. S. "Pendarves" in Graving Dock for Repairs at Immingham Mobilization Dock.

class was remarkable. The darkened streets, whose gloom was at times increased by an almost impenetrable fog, created the bigger demand and the plentiful supply of money in the pockets of the workers, including juveniles, young women in city commercial offices and in munition works, made purchases possible so long as the stores of lamps and batteries were unexhausted. On Christmas eve the run was at its maximum and long before the shopping hours expired batteries for refills were unobtainable and empty cases and lamps were all that were on show or on sale. American types of batteries were largely sold and helped the situation out magnificently. In the streets policemen were supplied with lamps, especially for the central parts of London, helmet lamps with batteries in pockets serving in some cases; in places the police held colored lamps as signals to guide vehicular traffic and to show safe crossing for pedestrians.

The British manufacturing capacity for portable electric lamps has been taxed to the utmost for a long time past in spite of great extensions of existing factories and the putting down of many new ones, multiplying the production of several times over. Before the war the business was making great headway, big efforts being made to defeat the competition from the Continent which had always been very keen for such lines. Since that competition has been shut off practically entirely, the efforts of English makers of batteries have resulted in much improved types being put upon the market. At times large numbers of "duds" have been sold which were traceable to particular works and some of them were suspected as to source of origin, for they found their way across the North Sea.

Fuel difficulties have given domestic consumers and commercial men a closer acquaintance with electric heating which will bear increasing fruit now that the folly of consuming coal in open grates in hundreds of thousands of offices and households each with their own separate storage accommodation has been brought home so emphatically. England now has a national electric power policy and food shortage has turned many expert electrical and agricultural minds in the direction of electroculture. Canteens for workers, military and auxiliary hospitals have displayed a marked appreciation for electric cooking. Powers in authority as well as the "common people" are "thinking electrically" as the result of all these developments and the electrical habits and custom of all are being formed and firmly settled.

Electrical Mobilization in France

Rapid Development of Hydroelectric Projects Most Important Step of Electrical Industry

By J. BLONDIN

Professor of Physics, Rollin College, Paris

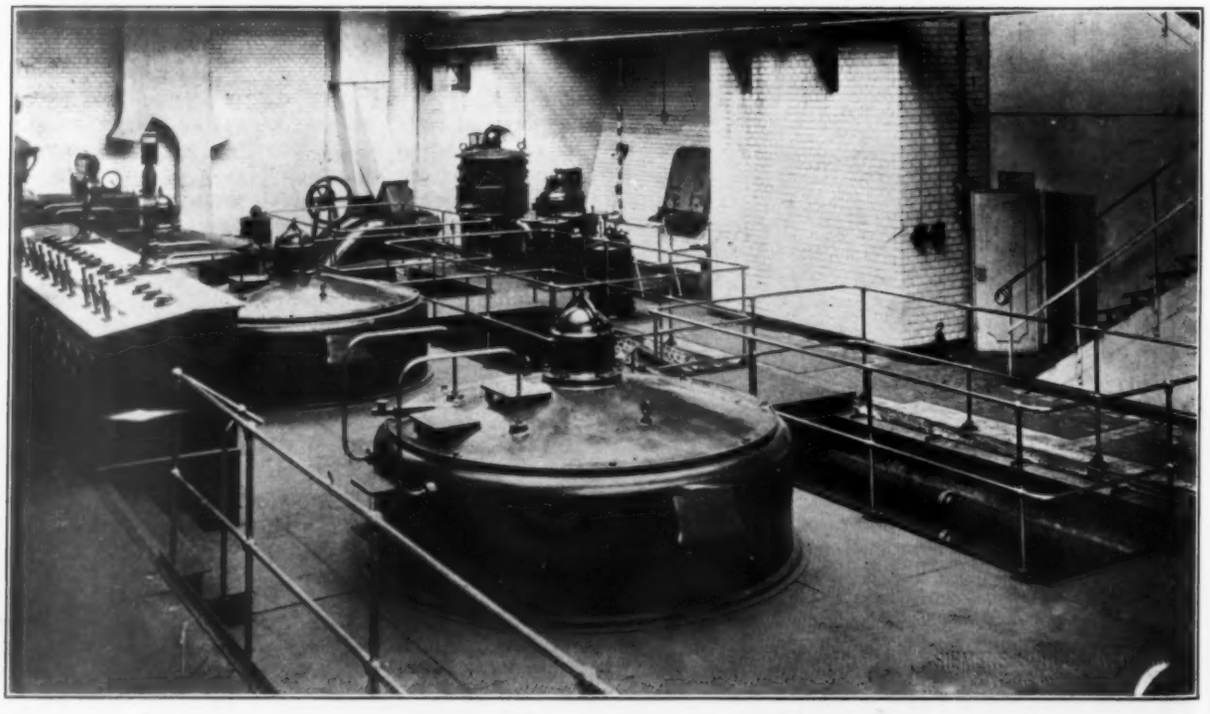
IF one understands by "mobilization" the preparation in times of peace of an organization having to be applied in times of war, there had not been in France any mobilization of electrical industries. The greater part of the French people were convinced of the impossibility of a war, and among those who even admitted the possibility of it, very few of them foresaw that the war would be above all a war of material and an economic war. Nothing had been foreseen that permitted the electrical industries either to contribute to the production of war material or for continuing the manufacture of electric material necessary to the economic life of the country.

It was not until after the declaration of war by Germany that the necessity of co-ordinating the efforts of the manufactories in view of the construction of material and of munitions of war was perceived. This co-ordination was realized very rapidly, thanks to the good common will of the directors and of the manufacturers. Certain electrical manufactories like those of telephones and microphones, of telegraphic and telephonic conductors, of ignition magnetos, etc., being of direct use in war material, were actively pushed; at the same time the works for electric construction utilized the mechanical material at their disposal for the manufacture of munitions of war. During a long time the engineers and workmen necessary for these manufactories had to be recruited entirely from among men not yet mobilized. A call was soon made for female hand labor, but it was not until the end of 1915 that the manufactories commenced to obtain the engineers and specialized workmen that had been mobilized in the armies. The wages of the workmen employed in these factories had given rise recently to a regulation dated the sixteenth of January, 1917, and which regulation was reproduced and discussed by Mr. F. Payen in the (Paris) *General Electric Review* of February 24, 1917, pages 317 to 320.

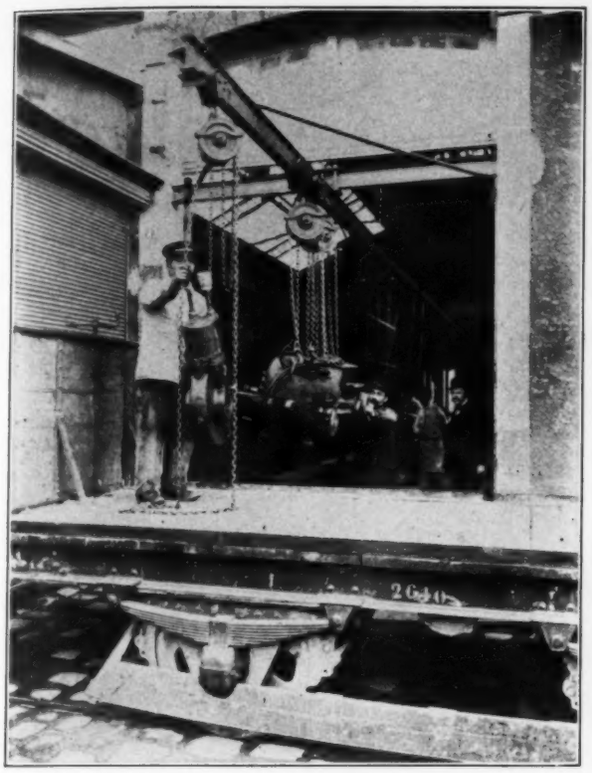
Enlargement of Factories Necessary.

The intensification of the manufacture of war material was not slow in requiring the enlargement of the existing factories and the creation of other very important ones. The electric force which had been adopted in all new installations resulted in a considerable increase in the consumption of electrical energy. To this increase there was added that resulting from the extension given to the old and new electrochemical manufacturers; such as chlorate of potash, aluminum, iron alloys, synthetic founding, nitric acid, etc.

In order to meet this increased demand it was thought at once best to utilize our great wealth of hydraulic motor power In the month of August, 1915, upon the initiative of the sub-



An Electrically Operated Pumping Station for a Dry Dock.



Loading Railway Motors of Lille-Roubaix Line on Flat Cars for Removal Behind Permanent Defense Lines.

Dismantling Railway Cars for Removal Behind French Lines.

Secretary of Artillery and of Munitions the manufacturers were invited to resume their studies on the generation of electricity from water power which had been abandoned since the opening of hostilities. This initiative proved a great success for it is estimated that the supplementary hydroelectric power that was available by the middle of 1917 was estimated at 120,000 horsepower. This supplement is far from being a negligible quantity, especially if one compares with it the hydroelectric power as it stood at the beginning of the war at only 600,000 horsepower. In less than two years there has been realized, in spite of difficulties of all kinds, an increase in power equal to one-fifth of the whole amount that had been produced previously in 25 years. The region of the Alps is that which has contributed most to this new development and some information may be found on this subject in the article of Mr. R. de la Brosse, chief engineer of Roads and Bridges, published in the (Paris) *General Electric Review* for February 10, pages 233 to 236.

The electrical generating works with thermic motors were therefore placed in a position to satisfy the increase in the consumption of power. At the end of 1916 the amount of power which they were capable of furnishing was estimated at 85,000 horsepower. The greater part of this increase, that is, 55,000 horsepower, has been produced in the district around Paris.

Nevertheless, and in spite of this great increase of 200,000 in the available electric force, the generating works hardly succeeded in meeting the ever-increasing demands of the consumers. It was necessary, therefore, to regulate the distribution of electrical energy. This regulation was effected in the decree of November 21, 1916, and which has been commented upon by F. Payen.

Electrical Industry Has Played Important Part.

In short, although there was no organization prepared before the war, the electrical industry has played an important role in the making of war material, the manufacture of explosives and in the furnishing of motor power for the factories working for national defense. This result has been obtained above all by the spontaneous co-ordination of efforts of the manufactories and managers, and the regulations which have been promulgated from time to time have had for their object that of stabilizing the organization already existing rather than that of seeking to impose a new one.

Ottumwa Company Secures Contract Covering Power Requirements for Five New Towns.

The Ottumwa (Iowa) Railway & Light Company has secured a 10-year contract for electric power and light at Batavia, Fairfield, Keosauqua, Bonaparte and Oakland Mills, Iowa, which are served by the Iowa Railway & Light Company. The Ottumwa Company will construct a 14-mile transmission line from Ottumwa to Batavia and deliver current on a wholesale basis. The present requirements under the contract amount to about 500 kilowatts and will be increased later by the addition of other business in the towns named and also by the addition of other communities.

Iowa Section Convention Abandoned.—The annual convention of the Iowa Section, National Electric Light Association, which was to be held at Des Moines, Ia., May 24 and 25, was abandoned and, at the time of going to press, L. E. Caldwell, secretary, announced that no definite plans had been formulated for the meeting of the Executive Committee, which was contemplated to conduct the routine matters in accordance with the constitution.

Wiring Installations in Pennsylvania Mines.—The Pennsylvania State Legislature is considering a bill, introduced by Representative Morgan, of Luzerne, providing that all wiring and motors installed in gaseous mines should be insulated.

Electrical Mobilization in Canada

War-Winning Activities of Canadian Electrical Men Furnish Incentive to Americans

By GORDON C. KEITH

Member, Ontario Committee of Technical Organizations.

WHEN the present conflagration began in Europe with all its inhuman force, shells were used at such a rate that the arsenals of the allies were overtaxed, and ways and means were discussed as to how to mobilize the industries to get an adequate supply. During the discussion the Canadian Minister of Militia appeared on the scene and he suggested that he place some orders with industries on this side of the Atlantic. When he arrived home he said that he did not see why Canadians could not make shells, and gathered around him a board of practical and successful business men and put the proposition up to them.

The outcome was the establishment of a "shell committee" to investigate facilities for the manufacture of shells and place orders for the imperial government. The success of the efforts of this committee is shown by the steady stream of munitions now being turned out by the Canadian factories.

One of the men selected for the shell committee, as then organized, was Lieut.-Col. George W. Watts, works manager of the Canadian General Electric Company and managing director of the Sunbeam Lamp Company. With one or two others, he was intrusted with the spending of millions of dollars. The business has grown from a capacity of 340 18-pound shells per week until now Canada has a capacity to turn out 400,000 18-pound shrapnel shells per week, including cartridge cases, fuses, propellers, etc., and 400,000 high-explosive shells of all varieties, a total of 800,000 shells per week. The shell orders placed in Canada have reached the enormous sum of $800,000,000 and the shipments are valued at $500,000,000. There are now 650 factories distributed through 144 towns in every province except Prince Edward Island There are 18,000 shell machines, valued at $35,000,000.

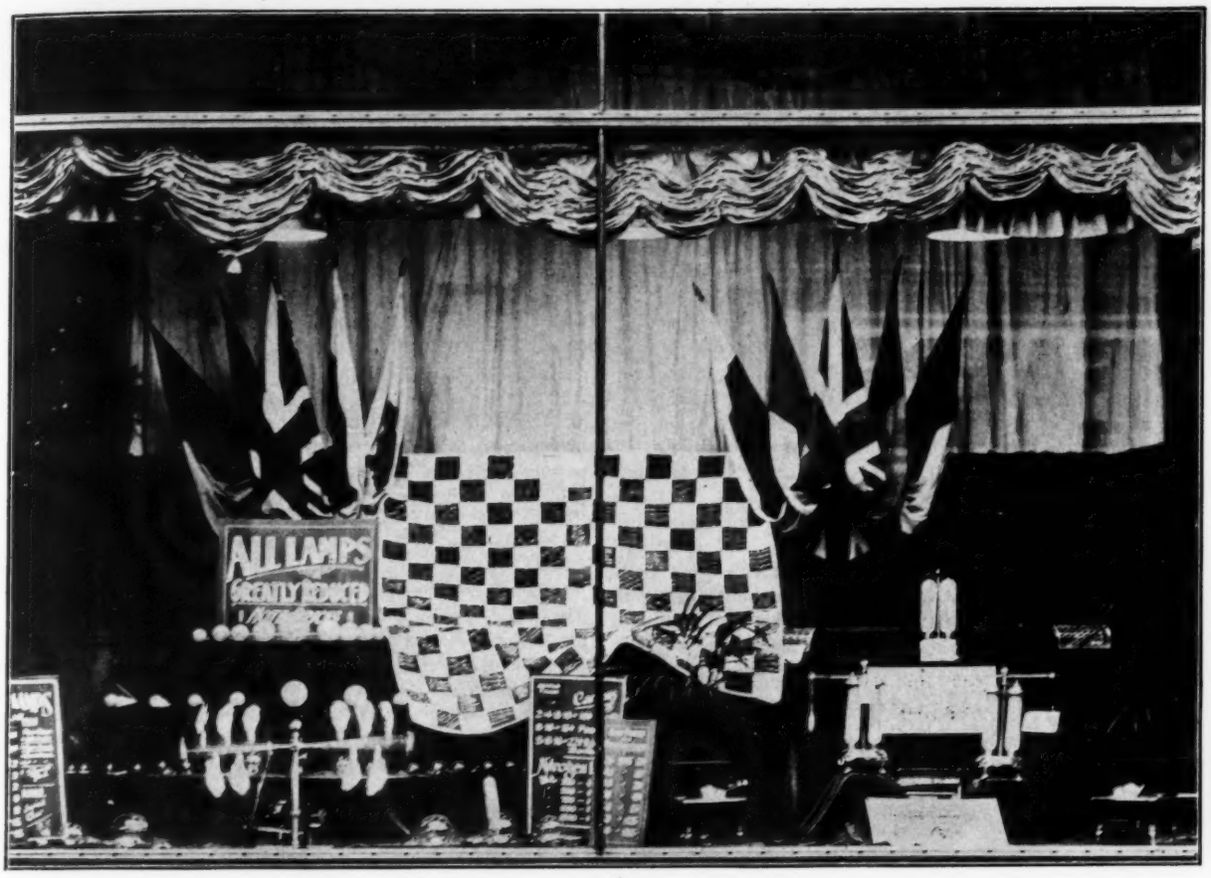
Among the electrical companies which took hold of the shell "game," as it has been termed, are the Canadian General Electric and the Canadian Westinghouse companies. These two large industries took up the work in a very efficient manner along with a number of the smaller electrical industries and have been turning out large quantities of shells, comparing favorably with the engineering works which would be expected to be more efficiently fitted for taking hold of such work. The fact that these firms were accustomed to very fine work made it possible, however, to produce initially shells made with the fine accuracy which is demanded. Large additions were made to the factories and special equipment installed so that they have been able to speed up production to an enormous extent.

Following the call for "shells and more shells" came the demand for "more men." Canada again rose to the occasion with her reply of several thousand and promises of more—500,000 if necessary. Four hundred thousand of these are now with the colors.

Women Take up Munition Work.

The men came from the office and the factory. Munition plants needed more labor to replace the men answering the call. The women saw their opportunity of "doing their bit" and organization meetings were held. Petitions were sent to the government who recognized the need of immediate action. Labor bureaus were established in all the prominent centers and they became the "go-betweens," where women who for patriotic or other reasons were willing to enter munition factories to help keep the boys in ammunition, could get in touch with manufacturers who needed help. Many women have taken up this task and will not give it up until freedom for the people of the world is assured.

Views in Munition Factories in Canada—Women Have Replaced Men Wherever Possible on Work of This Character and Are Here Shown Operating Punch Presses and Lathes.



A Patriotic Window Display Maintained by Toronto Electrical Concern.

Women are employed at a great variety of tasks, including lathe work, press work, inspecting, etc. One of the illustrations, for example, shows a group of women engaged in making cartridge cases at the Davenport works of the Canadian Allis-Chalmers Company. Another group of patriotic women workers is shown making percussion primers at the factory of the Canadian General Electric Company at Peterborough.

At these factories where women are employed special lunchrooms, washrooms and other conveniences are provided for the women so that they may carry on their work with as little discomfort to themselves as possible. In some of the factories women have been wearing overalls of a special type, close fitting at the wrists and ankles, but the best appearing suit is the one with the long coat, such as is worn by the toolmakers, with close fitting wrists and small caps.

When war was declared the Canadian Westinghouse Company had completed a large new double-deck foundry. A request was made to the company for permission to use this as an armory and since then it has been used for that purpose.

Senator Nicholls an Active Worker.

Hon. Frederic Nicholls, President of the Canadian General Electric, has been very actively engaged in the collection of money for the Patriotic and Red Cross funds and has been a very liberal contributor. He is a member of the executive committee of the general council of the Canadian Patriotic Fund and is chairman of the Toronto Branch of the Red Cross Society.

On August 6, 1914, immediately following the outbreak of war, Mr. Nicholls sent the following telegram to the Canadian Premier:

"The Board of Directors of the Canadian General Electric Company, after full consideration, and having regard to the present serious war situation, have resolved to submit to your Government an offer to raise, equip and pay the salaries of a company of twenty-five skilled electrical and mechanical operatives who would be available for service in any part of the Dominion and be under the control of the Minister of Militia as part of the Canadian forces. Probably their services could be utilized in the erection, repair and maintenance of wireless telegraph stations, cable stations, bridges, transport vehicles, artillery, etc."

The same day Mr. Nicholls received the following reply from Mr. Bordem:

"The Government of Canada warmly appreciates patriotic offer of Canadian General Electric Company embodied in your telegram just received, and send their sincere thanks. Your telegram has been submitted to Minister of Militia, who will communicate with you thereon."

This corps of engineers was immediately appointed and has been doing excellent service. In fact, so useful were they that whole battalions of engineers have since been recruited and sent to the front.

The Central Station and the War.

The central stations have been placed in a very peculiar position by the war. Employees have been enlisting and at the same time the demand for power for munition factories has been increasing. Companies generally are sold to their capacities and additions are being made as rapidly as new equipment can be obtained. As an example, reference might be made to the Toronto Hydro-Electric System, which represents pretty near the general situation. About 150 men formerly employed by this service are at the front. At the same time, due to the demand for power for munition plants, the Toronto Hydro is now supplying power to these industries with an installed motor capacity of 30,000 horsepower. At the present time the Toronto Hydro has signed up for industries employed on war supplies an additional 25,000 horse-

power in installed capacity, so that in a very few months this service alone will be supplying about 50,000 to 60,000 horsepower installed motor capacity.

The Toronto Hydro-Electric Commission has also made generous grants to patriotic funds, and has supplied current free in cases where it was of assistance to recruiting or to the comfort of returned soldiers. The men who have enlisted from this service to date have not had to suffer from any reduction in salary, as the difference between the soldier's pay and that received when at work in the Hydro's service was paid by the Hydro. For the year 1916 this amounted to between $25,000 and $30,000.

Not only has the Hydro used its large window fronting on Yonge Street to stimulate recruiting but it has assisted the women in the raising of funds by using window space for that purpose. One of the illustrations shows one of the windows in which is an autograph quilt. The idea is to let the public know how they can contribute to the hospitals, that is a name is worked on the quilt for a certain sum. The amount paid is used for hospital quilts and other supplies.

Women are filling the places of men in central-station offices wherever possible, thus releasing men for service at the front. Owing to the nature of central-station work they have not taken up the practical tasks. Should the war continue, however, and there be a further demand on the manpower of the country, there is no telling what further fields of endeavor women may enter in the coming months.

Electrical Clubs Active.

In addition to the methods adopted as outlined above, several of the Electrical Luncheon Clubs have assisted recruiting by inviting representatives of the engineering staffs in the military districts to address the members. In this way a number of electrical men were enlisted in the Canadian Engineers. Several of the electrical employers took up the question and gave the recruiting officers assistance in securing men for that branch of the service. The clubs also gave dinners to the returned soldiers. This was financed by each member being asked to be responsible for one soldier. The entertainment at such gatherings was given by returned soldiers.

To assist production the Toronto Electrical Club has taken over a plot of ground consisting of about 50 acres on which potatoes will be grown, the work in connection with which will be done altogether by the club. To finance the project $250 was asked for at their meeting on April 2 and it was subscribed in less than five minutes. The secretary has figured that it will take 400 hours' work to cultivate this "farm" and this has been provided for by members offering to spend one week's vacation at this work. The crop will be sold at a fair price and the funds will be given to the Red Cross.

Mobilizing Technical Men.

Some months ago Willis Maclachlan, secretary of the Toronto Branch, A. I. E. E., conceived the idea of utilizing the experience and knowledge of the Canadian engineers to help win the war. As a result of his efforts a joint committee of technical organizations was formed in Ontario and through further efforts similar committees were formed in the different provinces. This is a very important association in connection with the mobilization of electrical men. The

View in One of Canada's Munition Works.

Women Now Do a Great Deal of the Work in Electrical Manufacturing Establishments.

idea of the committee is to lend technical knowledge in the service of the country. The objects are clearly set forth in the following rules:

"The object of the joint committee shall be to devise ways and means by which engineers and other technical men may, as a result of their special training and experience, render assistance in the development and government of our Dominion. The immediate aim shall be to evolve a plan or plans whereby such of these men who for business, family or other reasons, are unable to go to the front, may be used for war purposes at home in such a manner as their special technical training may make them most valuable."

This committee is formed of appointed representatives of recognized technical societies. They meet once a week, but an executive committee meets almost daily to parcel out work and deal with urgent matters. Among the things dealt with are inventions submitted to the Imperial Munition Board on which reports are obtained, recruiting in the engineering branches of the service, employment of returned engineering or executive men, and the giving of technical advice to manufacturers engaged in war work.

The committee in each province has made a canvass of all technical men and men of practical engineering ability compiling accurate information as to each man's special ability and qualifications. This information has been carefully indexed and the information should prove of great use when the mental as well as the physical resources are organized to defeat a common enemy.

Willis Maclachlan is the energetic secretary of the Ontario Committee. Other electrical men on the Ontario Committee are: H. H. Cousins, manager, Toronto Hydro-Electric System; William A. Buck, Canadian General Electric Company; D. H. McDougall, Toronto Electric Company; Lieut. J. C. Armer; E. T. J. Brandon, American Institute of Electrical Engineers; S. L. B. Lines of the Institution of Electrical Engineers, Walter Carr and Gordon C. Keith.

Electrical Training for Disabled Men.

By Albert H. Bridge.

The experiment initiated by the Institution of Electrical Engineers in England early in 1916 in connection with the training of disabled sailors and soldiers for electrical substation work in the electrical engineering department of the Northampton Polytechnic Institute, London, is making considerable progress. The course is one of three weeks, and the eighth of these courses commenced in April this year. The number of applications for admission down to that date was 164. Those actually commencing the course numbered 130. The number approved for employment is 114, and the number actually placed in positions 108. The applications received from employers number over 205. The disablements which have been found not to disqualify for all posts of the kind at which the training aims, are total disablements of one arm or one leg, or a partial disablement of one limb. The disabled man suffering from shell shock cannot be accepted. Up to the present the whole of the men who have taken sufficient advantage of the training to secure the recommendation of the joint committee under which the training is being managed, have been placed out, and there are still many vacancies to fill, but increasing difficulty is being found when placing men with serious arm disablements. It is suggested that in certain cases such men might be utilized for this work by simple modifications of parts of the switchgear, and the patriotism of electrical station engineers throughout the United Kingdom is being appealed to to consider carefully the possibility of employing men who have lost partially or wholly the use of one arm.

Those who are engaged in the vast problems of fitting out for industrial life the hundreds of thousands of men in Europe who have lost limbs in the war, are up against innumerable new questions such as the above. What has been achieved is really wonderful, but new points are continually arising. From the United States great assistance has been rendered by the designers and makers of false limbs. Some soldiers, fitted out afresh, have been heard to declare in the novelty of their new possession: "This leg is a far better one than the old thing I lost!" In the writer's experience it is the man who has lost his right arm who feels his position most keenly as he tries to prepare himself to resume his normal occupation or take up some new one. A need of the hour seems to be for a co-ordination of practical research and practice in such matters between all the allied countries.

Illuminating Engineering Society's Convention Postponed.

As previously announced in these columns it had been planned to hold the eleventh annual convention of the Illuminating Engineering Society during the latter part of September. At a meeting of the council of the Society held in New York City on May 10, it was decided on account of war conditions to cancel the actual convening of this meeting. According to present plans it is intended to continue with the preparation of the papers as had been planned, but instead of assembling for their presentation and discussion it is proposed to send copies to all members interested and ask them to submit written discussion. All of the papers with the discussion will be printed in the *Transactions* of the Society as usual.

Mobilization Problems of the Central-Station Industry

An Explicit Statement of the Conditions Which Confront Utilities And What Steps Can be Taken to Meet Them—Abstracted from N. E. L. A. Presidential Address

By HERBERT A. WAGNER

Past President, National Electric Light Association

THE rapidly changing conditions which have been coming over the business and industrial enterprises of the country during the progress of the war in Europe have presented many new problems and new opportunities to all our public utilities. The dependence of the public upon the service of electric central-station companies has been more clearly demonstrated than ever before, and the growth of the demand for central-station power on the one hand, and the decadence of the isolated plant on the other, have been unprecedented.

H. A. Wagner.

Consequently there are before us today greater opportunities for the extension of our power service and for the practical elimination, through obsolescence and inadequacy, of all other sources of power for the country's industries, great and small, than the greatest optimist could have dreamed of a few years ago. In grasping these opportunities we are only limited by our ability to finance our unprecedented requirements, by the increasing difficulty of obtaining deliveries of apparatus and supplies, and by the greatly increased cost for all equipment which may become well nigh prohibitive without an increase in rates for service. The weighing and balancing of these opportunities and obstacles have constituted one of our greatest problems within the last few months.

Public Utilities and Preparedness for War.

Throughout this great country the action of the government at Washington in declaring its intention to take its place with the Entente Allies in the war against the Central Powers has met with a response most gratifying for the spirit of patriotism and unity exhibited. Whatever doubts and differences had previously existed have been solved or subordinated to the national policy, and when the government took its final stand upon this ground the country showed a united front.

The war has now lasted nearly three years and has become the most awful tragedy of the time, and our duty is to bring it to an end, if possible, under conditions which will give some assurance against the recurrence of a similar calamity in the future. In this task the United States has now joined, and, until it is accomplished, all energies which can be effectively directed to this end should be so devoted. The government rightfully has a first call upon all the resources of the country for this purpose, and the steps which it is taking indicate that it intends to organize its force of men, equipment and materials as rapidly as possible.

There is every evidence of loyal co-operation. The owners of industrial works producing munitions and other war supplies are freely offering their establishments for government service; the railway companies have practically merged their property into one organization for the purpose of giving the country the most efficient service possible. It is important that there should be a general understanding that while the war lasts it is to be the principal business of the country.

When the war began a cry was raised in England of "Business as Usual," but before long it was apparent that business could not go on as usual, and all efforts were turned to the curtailing of unnecessary expenditures, for the double purpose of subscribing for the war loans and releasing labor for absolutely necessary work.

Some fear has been expressed in this country, however, that a general impulse for economy might suddenly contract the volume of business to such an extent as to disorganize industry, throw wage-earners into idleness, and create a general state of alarm and confusion which would seriously impair the ability of the country to deal with the great emergency which confronted it. Many are urging that it is better for each person to go ahead in his accustomed way and with his usual expenditures than to run the risk of disturbing the orderly movement of trade by encouraging a general change of pace. It seems to be generally agreed, however, that there will have to be material changes in our industrial methods and energies, and a reduction of expenditures in many lines. But these changes should come about gradually and automatically, as government orders are given preference over private orders, by the effect of high prices, by the influence of taxation, and by the patriotic desire to participate in the war loans.

There is no prospect of less work to be done in this country; there is more work in sight than ever before, and expenditures will not be lessened but will merely be shifted to new channels.

Must Avoid Hysteria and Impulsive Action.

It is imperative that in all these readjustments we must avoid hysteria and impulsive action. A warning against indiscriminative economy was recently issued by Howard E. Coffin, of the Advisory Committee of the Council for National Defense, which might well be quoted here in part, as follows: "After nearly three years of refusal to take the European war and its lesson seriously, we suddenly launched forth in a most feverish activity to save the country overnight. Patriotic organizations, almost without number, are milling around, noisily, and, while intentions are good, the results are often far from practical. Because of an impending and possible shortage of foodstuffs, we have hysterical demands for economy in every line of human endeavor. Waste is bad, but an undiscriminating economy is worse.

"General business is being slowed down because of the emotional response of the trading public to these misguided

campaigns for economy; savings are being withdrawn from the banks; reports show that some people have begun to hoard food supplies, and thousands of workers are being thrown needlessly out of employment. All this is wrong. Unemployment and closed factories, brought about by fitful and ill-advised campaigns for public and private economy, will prove a veritable foundation of quicksand for the serious work we have at hand. It is true that the President has said that this is a time to correct our habits of wastefulness. Certainly. But the keynote of his message to the people was this paragraph:

"'It is evident to every thinking man that our industries on the farm, in the shipyards, in the mines, in the factories, must be made more prolific and more efficient.'

"We need prosperity in war time even more than when we are at peace. Business depressions are always bad, but doubly so when we have a fight on our hands. The declaration of war can have no real evil effect on business. What bad effects are apparent are purely psychologic and largely of our own foolish making, for our markets are the same in April that they were in March. We need more business, not less. There is real danger in hysteria. Indiscriminate economy will be ruinous. Now is the time to open the throttle."

It is the time for the public service companies to consider without delay the part which we must play and the action which we should take in connection with the general preparedness plans and the readjustments which must take place. We have many problems before us which need careful deliberation, requiring the utmost of co-operation and practical co-ordination with the broad scheme of industrial adjustment.

Few outside of the public service industry realize to what extent the industries of the country and the entire machinery of production are dependent upon electric light, power and gas. It is safe to say that there is today no class of industry, no kind of manufacturing enterprise, which is not dependent upon electric central-stations for power or light, or both. Within the last two years the expansion of factories and mills engaged in the production of munitions for war and the various materials used for their manufacture has resulted in greatly increased use of central-station electric power.

Position of the Central Station.

Manufacturers in general have turned to the central stations to supply their power requirements, rather than submit to the delays, uncertainties and unnecessary investment in providing their individual power plants, realizing also that both for reliability and low cost of power, central-station service is most advantageous. The public utilities are thus standing behind the supply of the various sinews of war, and it is of paramount importance that service should be continued with undiminished efficiency and reliability, and even extended where necessary.

Light for our streets and homes provides the most effective protection and security against all forms of disorder and crime which the unsettled conditions may encourage.

In order to maintain our service with undiminished effectiveness it is, of course, necessary that the public utilities should retain at least the greater part of their forces of skilled men, and prompt measures must be taken to offset the effect of enlistment and the application of the selective draft in decimating our organizations. We must find ways and means of holding the bulk of our men in their present jobs without discouraging enlistment or in any way embarrassing the government in raising the required military forces.

It is most desirable for us also to consider what position we are to take in contributing toward the support of those dependent upon our employees who enlist or who are drafted. Undoubtedly, our inclination is to be liberal in our contributions but, on the other hand, the limitations of our financial resources, particularly in view of the great increase in the cost of fuel and supplies, and the possibility of curtailed earnings, must warn us to pause before taking precipitate action which we may afterwards be forced to modify.

The Fuel Situation.

One of the most serious problems which confront us is the scarcity of fuel, or the means to assure its delivery in such regular quantities as our requirements demand. Some prompt and well organized action must be taken to bring before the proper government authorities the extreme urgency of the adoption of measures which will place public utilities in a preferred class for fuel supply. Without doubt, our central-station companies will be called upon for increased service for many industrial purposes in connection with government contracts for munitions and supplies, and this possibly without a proportionately diminished demand for the usual commercial and domestic service. With the slow deliveries of equipment and apparatus for extensions, and the possibility that available supplies may be commandeered by the government, we are faced with the possibility of increased demand upon our output beyond our capacities to supply. In such a contingency we will undoubtedly be forced to give preference to government requirements, and this may bring before us questions of discrimination which will present difficult problems in themselves, and will no doubt call for relief through federal enactments which would absolve our companies from penalties prescribed by existing local laws.

Another urgent question confronting us is the necessity and obligation of protecting our properties against interference, damage or destruction by the hands of fanatics, enemy agents and mobs. The extent to which such protection is desirable or feasible, and the best means of securing it, considering both the urgency and expense, are matters upon which there are widely diverging opinions and counsel.

Middle Western Utilities Faced with Coal Shortage.

Coal is again a source of anxiety to the managements of public utility plants in the Middle West and Central South. Embargoes put into effect by railroads entering the gateway cities of Louisville and Cincinnati, dating May 17 and earlier, disclose the condition by exempting coal for utility companies from terms of the embargo, which is ascribed to congestion. Perishable freight and government supplies are alone excepted, aside from coal for utilities, all railroads north from Cincinnati and all except the Monon and the Pennsylvania out of Louisville being included. Even in the inland towns in Kentucky, which are only short hauls from the coal mines, programs of economy on coal are in effect, on account of the difficulty in getting it and the unprecedented price. At Augusta, Ky., for instance, the lighting plant shuts down at midnight to save coal. Larger consumers, covered by contract, have in numerous cases voluntarily increased their rates of payment to operator holding the contract, the idea being that this course would tend to make the same operator more keen to take care of the consumer during the coming winter. Buyers representing northern industrial consumers have invaded the Kentucky coal fields and are bidding prices up on each other in order to get coal. Utilities south of the river will benefit while the embargoes hold by being able to get their coal at something of a reduction in price.

Toronto Electrical Contractors Meet.—A meeting of the Toronto Electrical Contractors' Association was held on May 7 to complete its organization. A secretary-treasurer and two executive officers were elected so that the officers of the new Association are now as follows: President, Kenneth A. McIntyre; vice-president, Harry Hicks; secretary-treasurer, J. Everard Myers. Executive Committee comprise the officers, George J. Beatty and W. H. Douglas.

New Electric Power Plant at Windsor

General Features of a Plant of Prime Interest Because of Its Size and the Promise of Extraordinary Economy Due to Efficient Design and Location at a Coal Mine and on a Large River

By F. H. BERNHARD

IN the mobilization of the country's resources for successful prosecution of the world war, an important element is the economical and reliable supply of power to those industries especially concerned with the production of the necessary munitions and related national supplies. No small part of the metal supplies for this purpose will be fabricated in the Ohio Valley between Pittsburgh, Pa., and Parkersburg, W. Va. Foreseeing the rapid increase in the power needs of this large industrial region, the projectors of what is probably the most important power plant now under construction have planned what gives every promise of becoming the most economical electric generating station ever built.

This may be a strong statement, but it is warranted by the exceptionally favorable location of the plant. It is at Windsor, W. Va., a few hundred feet from the Ohio River and within one-third mile of a large coal mine from which an excellent quality of steam coal will be obtained in unlimited quantities on a long-term contract. The coal will be handled by means of a private locomotive and cars direct from the mine tipple into the boiler room. Thus will be removed at one stroke the danger of coal shortage, which has proved so troublesome to many central stations within the past winter. The plant is situated in the midst of, or reasonably close by, a number of central-station systems, several of which are in urgent need of greater and more economical power supply, so that a market for the power to be developed is already waiting. All these favorable conditions, together with a station design involving large and highly efficient units and other important features to be referred to briefly below, are bound to make for unusual economy and reliability of service.

Before taking up a general description of the new plant it is appropriate to review the conditions that led to its erection. The western part of Pennsylvania, eastern part of Ohio, and the northwestern part of West Virginia have become the most important center of the iron and steel industry of the country, because of the ability to get economically, on the one hand, iron ore brought down to the Lake Erie ports, and the other hand, good coal brought from the mines of Pennsylvania, Ohio and West Virginia. In this vast region there is a multitude of large iron and steel mills and of foundries and

Left Half of General Panoramic View of New Power Station at Windsor, W. Va. The Large Structure is the First Section of the Boiler Room. Turbine Room is on River Side. Concrete is Being Discharged Over the Turbine Room to the Foundations for the Southern Section at the Extreme Left.

factories of various sorts in which the iron and steel are manufactured into structural building material, rails and other railway supplies, machinery, hardware, etc. In iron and steel works there has been going on for several years a rapid electrification of machinery drives, not only of rolling mills but of cranes, furnace-charging machines, hoists and lifting equipment, etc., and a steady addition has been made of electric furnaces for refining steel and making steel castings. The electric power demands of these steel mills and of the varied factories for further manufacture of the iron and steel into finished products have in a few years grown to such magnitude as to be greatly beyond the capacity of what generating equipments they possessed and consequently they have availed themselves of power supply from central-station companies.

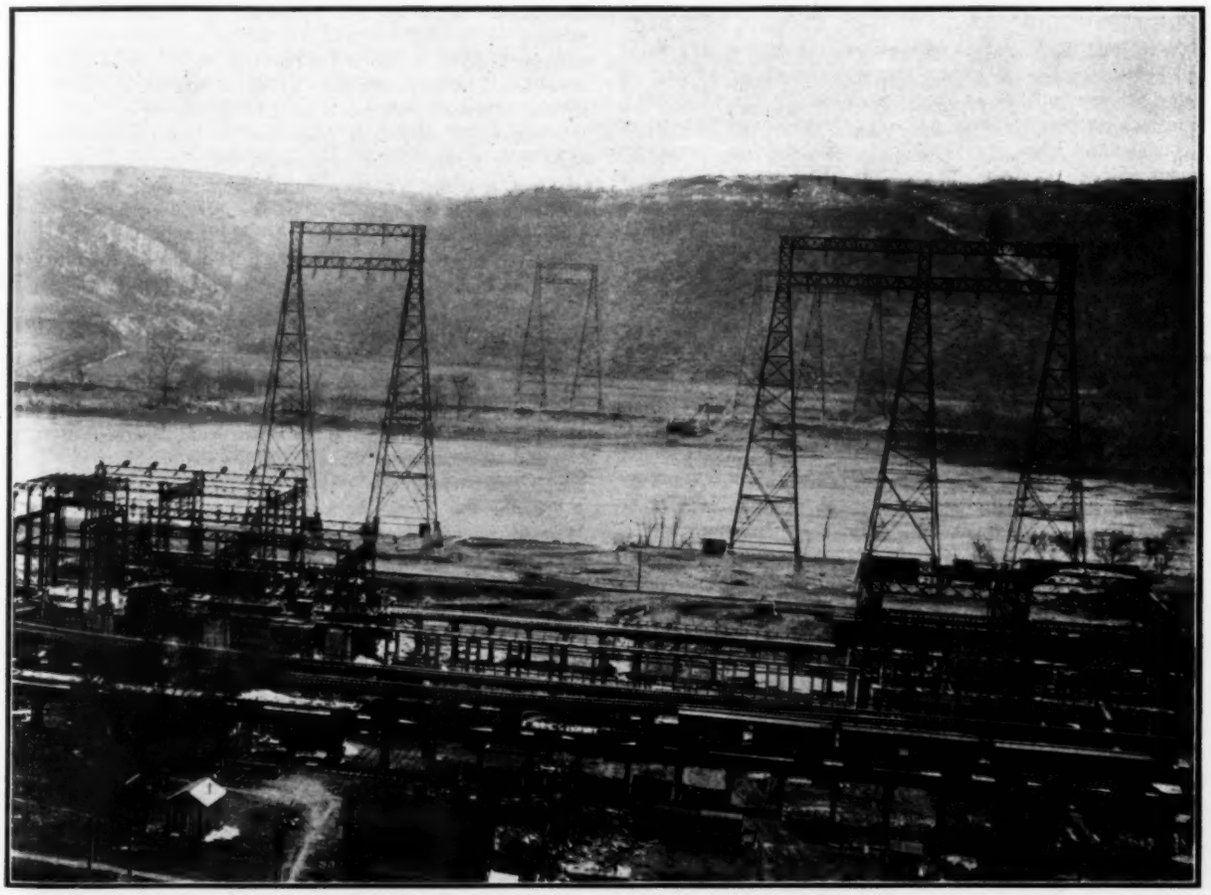
Power Conditions at Canton, Ohio.

A notable instance of this electrification of industries is found at Canton, a progressive city in the eastern part of Ohio. The population of this city has increased by over 60 per cent since the 1910 census and is now over 80,000. Its industries also have been forging ahead by leaps and bounds and are of a most varied character, steel predominating, however. The city has recently become one of the leading centers for the production of electric steel, six electric furnaces having been placed in service within the past year. One of the largest plants for the production of special alloy steels now so urgently needed in the metal industries is located at Canton; this plant is now being practically doubled in capacity. There are also situated at Canton large plants for the production of sheet steel, roller bearings and axles for automobiles, metal ceilings, corrugated roofings, gas engines, street-lighting standards, metal furniture, hardware, etc. In practically all these industries the use of electricity has been making rapid strides and practically all of the electric power needed has been purchased from the Canton Electric Company, now appropriately renamed the Central Power Company.

The load on this central station has consequently during recent years made extraordinary increases, which have come at an almost steadily accelerated rate. For instance, during the four months from December, 1916, to April, 1917, the demand increased by about 13,500 kilowatts, or over 100 per cent, practically all of this coming from old customers. Such increases in load were bound, of course, to tax the capacity of the plant and to meet them additional boilers and turbogenerators were added, but it was almost impossible to secure the requisite equipment fast enough.

The Central Power Company's plant is situated near the center of the city and was well designed for its original needs. Even now practically all of its equipment is modern, including three Curtis turbo units of 10,000, 6250 and 5000 kilowatts. The total generating capacity installed is 25,600 kilowatts. The maximum demand on the plant, however, has now frequently exceeded 26,000 kilowatts. The load-factor is very high, the load at 2 a. m. being often 19,000 kilowatts and even on Sunday afternoons it has run occasionally from 15,000 to 22,000, due to heavy demand from the continuously operating steel mills.

From the central-station standpoint these are ideal conditions, except for the danger of operating too near the actual maximum capacity and of forcing the plant to greatly beyond what its original location and design contemplated. This latter fact has militated against economical operation. For condensing water the plant draws on some 110 wells, since there is no river or lake anywhere near the city. A spray cooling



Right Half of Panoramic View at Windsor Plant. At Left is the 130,000-Volt Outdoor Switching Station and Two-Circuit Line Crossing Over the Ohio River. At Right is the 66,000-Volt Switching Station and Four-Circuit River Crossing. River Span is About 1,500 Feet.

pond is used in this connection, but the limited water supply and space available permits economical operation from the condensing standpoint for a load of only about 15,000 kilowatts. Therefore with the forced loading imposed on the plant recently only a relatively poor vacuum has been possible. Moreover, there is but limited space for coal storage in view of present demands.

Over two years ago the almost desperate power situation developing at Canton was foreseen and the Canton company therefore urgently appealed to its parent organization, the American Gas & Electric Company. The matter was immediately investigated with great thoroughness. It was found inexpedient, except for temporary purposes, to enlarge the Canton plant at its present site. To build a new plant in the outskirts of the city was also impracticable because of the scarcity of condensing water; in fact, there was no large, dependable body of water nearer than the Ohio River, some 55 miles away.

Conception of the Windsor Plant.

Other subsidiaries of the American Gas & Electric Company in adjoining portions of Ohio and West Virginia around Wheeling were facing similar, though not so aggravating, power conditions as the Canton company. Since the Wheeling district offered abundant and economical supplies of coal and water, which were not available nearer to Canton, it was decided to locate a large plant there and from it supply all of the related central-station companies. The wisdom of selecting this location has become more and more apparent as the construction of the entire project has progressed.

The site of the plant is at what was formerly known as Beech Bottom, now renamed Windsor, about six miles north of Wheeling, W. Va. It is on the east bank of the Ohio River and between a branch of the Pennsylvania Railroad and an electric interurban line of the West Penn Traction Company, thus making possible easy delivery of machinery and other materials and also providing for additional or emergency means of coal supply. The coal mine previously referred to is that of the Ridgeland Coal Company and is already connected to the plant by a short railroad equipped and operated by the American Gas & Electric Company. The coal to be supplied under a favorable contract is known as Pittsburgh No. 8 and has a heating value of about 13,000 British thermal units. Space will be available adjoining the plant for open-air storage of at least a month's supply. In the coal-receiving section of the boiler room there will be space for about a week's supply, thus every possible contingency relative to coal supply has been provided for.

General Features of the Plant.

Work on the plant was begun late in November, 1915, and has been prosecuted continuously barring delays due to difficulties in getting delivery of materials. These difficulties have been serious at times and have hampered systematic progress of the construction. The first unit in the plant will be placed in operation probably in July. The plant is being built in three sections, of which the middle one is now nearing completion. Work on the foundations for the southern section is already under way and when this portion is completed work will be begun on the northern section. In the original plans it was thought that more or less of an interval would ensue between erection of the three sections. However, the power demands have recently become so insistent that it was decided to erect the sections progressively with as little delay as possible. There is every indication that as each unit is added it will be operated at practically full load.

The generating equipment in the completed plant will consist of six 30,000-kilowatt units. These will be Curtis horizontal steam turbines direct-connected to three-phase, 60-cycle, 11,000-volt generators. The turbines will exhaust into Westinghouse surface condensers, each of 50,000 square feet condensing surface. Each turbine unit will be supplied by four 1,260-horsepower Babcock & Wilcox boilers with Westinghouse underfeed stokers. There will be one steel stack for each three boilers. The complete plant will therefore have 24 boilers and 8 stacks. The boilers are arranged in two rows with their backs on a central coal-handling section. The boiler room is along the east side of the plant and is somewhat higher than the turbine and generator room which is along the west side. Both these main rooms have the same floor level which is 19 feet above the highest recorded stage of the river, thus eliminating any troubles due to floods. The foundations extend something like 100 feet below these floor levels.

The operating and low-tension switching rooms will be at the western side of the plant. All high-tension apparatus, including oil switches, transformers, lightning arresters, and other auxiliaries is of the outdoor type and being grouped into three separate high-tension switchyards to the north of the plant. These are connected with the generator buses by means of cables inclosed in fiber ducts that are run in concrete tunnels. At present these look more like galleries because of their height above the original ground level. It is plannd to fill in to nearly the turbine and boiler-room level by dumping the cinders from the plant, thus disposing of them to good advantage and very economically.

Practically all the power developed at the plant will be transmitted from it at either 66,000 or 130,000 volts. The power to be sent to Canton will be at this higher voltage. The two-circuit tower line to Canton is 55 miles long and is already built and in partial operation (at 66,000 volts, however) being supplied temporarily from the plant of the Wheeling Electric Company, which is dispatching from 2000 to 7000 kilowatts to relieve the Canton situation.

The 66,000-volt lines from the plant, of which four circuits have already been run across the river to connect with the transmission system running from the Wheeling plant, will supply the growing load of the Wheeling Electric Company on the West Virginia side and the rapidly extending system of the Sunnyside Electric Company on the Ohio side, both these companies being subsidiaries of the American Gas & Electric Company and furnishing the electrical supply of a large Ohio Valley district around Wheeling.

There will also be supplied from the plant from a separate switchyard at 66,000 volts considerable energy to the extensive system of the West Penn Traction & Water Power Company, which controls quite a few local central-station and traction companies principally in the district between Pittsburgh and Wheeling.

From the foregoing condensed general account of the Windsor plant and the related works of this large power project it is evident that it has been conceived on a generous scale and on a co-operative basis to meet the exceptional power situation confronting the central-station companies of the district between Wheeling, Canton and Pittsburgh. It represents an important step forward in effective marshalling of one of the country's most important resources—power—so as to place this at the disposal of the industries that need it so urgently at this critical time.

No effort has been made in this article to go into the details of this important power project. In the issue of June 2 will be published a somewhat detailed account of the river crossing of the transmission circuits at Windsor and of the Windsor-Canton 130,000-volt line. In the issue of June 9 will appear an article on the Canton substation. After the Windsor plant is placed in actual operation there will be published a more detailed article on its design and construction.

Nikola Tesla Receives Edison Medal

Notable Program at Annual Meeting of American Institute of Electrical Engineers—Interesting Insight into Mr. Tesla's Life and Work as Disclosed in His Address of Acceptance

Nikola Tesla, inventor and scientist, was presented the seventh annual Edison Medal at the annual meeting of the American Institute of Electrical Engineers held at New York City on May 18. Announcement of this award was made in our issue of May 5. This notable event, with the memorable addresses made by A. E. E. Kennelly, Charles A. Terry, B. A. Behrend, and particularly by Mr. Tesla himself, formed the principal item of the evening's program, which also included the annual report of the Board of Directors and announcement of letter ballot on the annual election of officers, which are reported elsewhere in this issue. After these business matter, had been disposed of, President Buck called on A. E. Kennelly, chairman of the Edison Medal Committee.

Nikola Tesla.

Dr. Kennelly gave an account of how the Edison Medal originated in a group of Mr. Edison's friends setting apart a fund in 1904 for the annual award to a living electrician of a medal for "meritorious achievement in electrical science and art." A deed of gift was drawn up designating the American Institute of Electrical Engineers to appoint from its officers and members a committee of 24 to determine the awards. Six noted electrical men have been recipients of the Edison Medal, as follows: Elihu Thomson, Frank J. Sprague, George Westinghouse, William Stanley, Charles F. Brush and Alexander Graham Bell. Dr. Kennelly stated that the medal award to Mr. Tesla was particularly for his development of the rotating magnetic field which is the fundamental principle that made possible the use of alternating current for operating motors, and also for his investigations of the phenomena of high-frequency currents.

Mr. Terry's Address.

Charles A. Terry, who was associated with Mr. Tesla in some of his research work, then made an eloquent address on Mr. Tesla's electrical achievements. After dwelling on the unselfish creative impulse of the inventor, Mr. Terry said: "Twenty-nine years ago this month there was presented before this Institute a paper of unusual import. It was entitled 'A New System of Alternate-Current Motors and Transformers.' The author, Nikola Tesla, was then only 31 years of age, and but four years a resident of this country. His early life was spent near his birthplace not far from the Eastern Adriatic Coast. His father, a Greek clergyman, and his mother, herself of an inventive mind, secured for their young son a comprehensive training in mathematics, physics and philosophy. At the age of 22 he had completed his studies in engineering at the Polytechnic School in Gratz and also a course in the University of Prague; and in 1881 began his practical work at Budapest. In 1883 he was located at Strasburg, engaged in completing the lighting of a newly erected railway station. Shortly after finishing this task he came to the United States. Mr. Tesla's first work in this country was upon new designs of direct-current arc and incandescent lighting systems for the Edison Company.

"Throughout all these years his desire had been to find an opportunity to demonstrate the truth of a conviction which became fixed in his mind while studying direct-current motors in school at Gratz in 1878; the conviction was that it should be possible to create a rotating magnetic field without the use of commutators. * * *

"By some fortunate process of reasoning he conceived, while in Budapest in 1882, that by using two or more out-of-phase alternating currents respectively passing through geometrically displaced coils it would be possible to develop his long sought progressively shifting magnetic field.

"Lack of funds and facilities for working out his theory compelled still further postponement, but in 1885 Tesla had the good fortune to interest men of means in a direct-current arc light which he had devised, and subsequently a laboratory was equipped for him in Liberty Street, New York, and here at last he found opportunity to demonstrate the correctness of his long cherished theory. In 1887 he was able to exhibit to his business associates and to Prof. William A. Anthony, whose expert opinion they sought, motors having such proggressively shifting fields without the use of commutators, as he had foreseen nine years before.

"Having thus demonstrated the correctness of his theory and the feasibility of its application, it remained for Tesla to work out various practical methods of applying the principle, and the rapidity and wonderful way in which he surrounded the entire field of constant-speed synchronous, induction and split-phase motors is beautifully set forth in his paper of May 18, 1888, and in the numerous patents issued May 1, 1888, and succeeding years, covering the forms of electric motors which have since become the almost universal means for transforming the energy of alternating currents into mechanical energy. * * *

"Among the first to recognize the immense importance of Mr. Tesla's motors were Mr. Westinghouse and his advisors, Mr. Kerr, Mr. Byllesby, Mr. Shallenberger and Mr. Schmid, and in June Mr. Westinghouse secured an option which shortly resulted in the purchase of the patents, thus bringing under one ownership the alternating-current transformer system of distribution, and the Tesla motor. * * *

"The impress made upon the world by the deeds of a great inventor can not be measured by the number of patents which he has received nor by the monetary reward secured nor by the mere exploitation of his name. Often his greatest gifts are in the form of inspiring contributions to the literature, filled with suggestions of lines of thought which lead others to work in untried fields. This is especially true of a series of lectures delivered by Mr. Tesla upon the subject of high-frequency, high-potential currents. The first of the series was given at Columbia College in 1891, before this Institute. During 1892 and 1893 this lecture with additional data and experiments was repeated in London, Paris, Philadelphia and St. Louis. * * * During these lectures he exhibited to the audience numerous experiments displaying striking and instructive phenomena. He also described many novel pieces of apparatus, such, for instance, as his high-frequency generator and induction coils and his magnetically quenched arc. * * *"

Mr. Terry quoted from many noted contemporaries of Mr. Tesla at that time their appreciation of the pioneer nature and

importance of his investigations in high-frequency phenomena and wireless transmission. As early as February, 1892, he had predicted these developments and "in his lecture before the National Electric Light Association at St. Louis in March, 1893, Mr. Tesla elaborated certain views regarding the importance of resonance effects in this field. * * * He then announced that his conviction had grown so strong that he no longer looked upon the plan of transmitting intelligence as a mere theoretical possibility, and referring to the existing belief of some that telephony to any distance might be accomplished 'by induction through the air,' concisely set forth his theory as follows: 'I cannot stretch my imagination so far, but I do firmly believe that it is practical to disturb by means of powerful machines the electrostatic condition of the earth and thus transmit intelligible signals and perhaps power.' * * *

"Throughout Tesla's work with high-potential currents he had persistently in mind the wireless transmission of power in large quantities. It was in the furtherance of this line of investigation that he expended large amounts of money and years of labor at Wardenclyffe, Long Island, and at Telluride, Colo. Late in 1914 he secured a patent upon an application filed twelve years before upon an apparatus for transmitting electric energy with which he hopes to be able to transmit unlimited power with high economy to any distance without wires. While as yet these efforts have not resulted in commercial exploitation, the future may prove that his dream of thus transmitting energy in substantial amounts is of that class which in time comes true, as in the case of his dream of wireless telegraphy.

"Another use to which Tesla adapted the results of his high-frequency investigations was the control of the movements of torpedoes and boats. In 1898 he patented such an apparatus and also built and successfully operated such a craft. The movements of the propelling engine, the steering and other mechanisms were controlled wirelessly from the shore or other point through a distance of two miles. Apparently this, like some of his other inventions, was ahead of its time. * * *

"Another field of investigation in which Mr. Tesla has contributed valuable material is related to the Roentgen ray. In the ELECTRICAL REVIEW during March and April, 1896, there appeared a number of communications from Mr. Tesla which, while giving full credit to Roentgen for his magnificent discovery, make public much additional data derived from his own careful experiments in this line of research. * * *

"Among the many other inventions to which Mr. Tesla has devoted much time and energy may be mentioned a thermomagnetic motor and a pyromagnetic generator, anti-sparking dynamo brush and commutator, auxiliary brush regulation of direct-current dynamos, unipolar dynamos, mechanical and electrical oscillators, electrotherapeutic apparatus, the oxidation of nitrogen by high-frequency currents, and an electrolytic registering meter. * * *

"One other line of endeavor entirely outside of electricity to which Tesla has given much attention is the development of a bladeless steam turbine in which the friction of the passing steam as distinguished from its direct impact is availed of. The steam is admitted between plain parallel rotating discs and passing spirally from the circumference toward the axial center imparts energy to the disks. Such a turbine can be run at exceedingly high temperatures, is readily reversible and, having no blades, is extremely simple and free from liability to accidental derangement. With great ingenuity Tesla has succeeded in producing such machines of considerable power and having exceedingly interesting characteristics. It is to be hoped that with his indefatigable zeal Tesla will soon succeed in perfecting the commercial application of this invention. It is not possible in this brief survey even to touch upon many of the lines of Mr. Tesla's varied activities, but we must content ourselves with this inadequate presentation of typical evidences of the fascinating genius of this man."

ADDRESS BY B. A. BEHREND.

"By an extraordinary coincidence, it is exactly 29 years ago, to the very day and hour, that there stood before this Institute Nikola Tesla," said Mr. Behrend. He then quoted from Mr. Tesla's paper on that notable occasion. Continuing, he said:

"Not since the appearance of Faraday's experimental researches in electricity has a great experimental truth been voiced so simply and so clearly as this description of Mr. Tesla's great discovery of the generation and utilization of polyphase alternating currents. He left nothing to be done for those who followed him. His paper contained the skeleton even of the mathematical theory.

"Three years later, in 1891, there was given the first great demonstration, by Swiss engineers, of the transmission of power at 30,000 volts from Lauffen to Frankfort by means of Mr. Tesla's system. A few years later this was followed by the development of the Cataract Construction Company, under the presidency of our member, Edward A. Adams, and with the aid of the engineers of the Westinghouse Company. It is interesting to recall here tonight that in Lord Kelvin's report to Mr. Adams, Lord Kelvin recommended the use of direct current for the development of power at Niagara Falls and for its transmission to Buffalo.

"The due appreciation or even enumeration of the results of Mr. Tesla's invention is neither practicable nor desirable at this moment. There is a time for all things. Suffice it to say that, were we to seize and to eliminate from our industrial world the results of Mr. Tesla's work, the wheels of industry would cease to turn, our electric cars and trains would stop, our towns would be dark, our mills would be dead and idle. Yea, so far-reaching is this work that it has become the warp and woof of industry. * * *"

PRESENTATION OF THE MEDAL.

President H. W. Buck, in presenting the medal to Mr. Tesla, referred to the developments of some 30 years ago when direct currents were used almost exclusively and it remained for Mr. Tesla to make alternating currents available for miscellaneous purposes by his great conception of the rotating field. This made power transmission immediately practicable and permitted the development of the Niagara Falls enterprise and countless other power developments necessitating the use of polyphase currents. Mr. Buck also spoke of Tesla's pioneer work in high-voltage and high-frequency currents, which laid the foundation for such important later developments.

MR. TESLA'S ADDRESS OF ACCEPTANCE.

In accepting the Edison Medal, Mr. Tesla expressed his deep gratitude for the sympathy and appreciation shown him. He admitted that "a gigantic revolution has been wrought in the transmission and transformation of energy. While we are pleased with the results achieved," he said, "we are pressing on, inspired with the hope and conviction that this is just the beginning, a forerunner of further and still greater accomplishments." He then entered upon a fascinating account of some features of a personal and more intimate character bearing on his work, which lack of space unfortunately prevents giving in full.

"In the first place, I come from a very wiry and long-lived race. Some of my ancestors have been centenarians, and one of them lived 129 years. I am determined to keep up the record, and believe there is a prospect of accomplishing it. Then, nature has given me a vivid imagination which, through incessant exercise and training, through the study of scientific subjects, and the verification of theories through experiment, has become very accurate in results, so that I have been able to dispense, to a large extent, with the slow labors, wasteful and expensive processes of practical development of the ideas I conceive. It has made it possible for me to explore extended

fields with great rapidity and get results with the least expenditure of vital energy. By this means, I may tell you also, I am able to picture the objects of my desires in forms so real and tangible that I can rid myself of that morbid craving for perishable possessions to which so many succumb. * * *

"My life was also wonderful in another respect, for physical endurance or energy. If you inquire into the career of successful men in the inventor's profession, you will find, as a rule, that they are as remarkable for their physical as for their mental capacities. I know that when I worked with Edison, after all of his assistants had been exhausted, he said to me, 'I never saw such a thing, you take the cake.' That was the characteristic way for Edison to express what I did. We worked from in the morning at half past ten until five o'clock the next morning. I carried this on for nine months without a single day's exception, but everybody else gave up. Edison stuck, but he occasionally dozed off on the table. * * *

"When I turned my thoughts to inventions, I found that I could visualize my conceptions with the greatest facility. I did not need any models and drawings or experiments, I could do it all in my mind, and I did. The way I unconsciously evolved what I considered a new method in materializing inventive concepts and ideas, is exactly opposed to the purely experimental method, of which undoubtedly Edison is the greatest and most successful exponent. The moment you construct a device to carry into practice a crude idea you will find that you will be engrossed with the details and effects of the apparatus. As you go on changing and constructing, you will lose the forces of concentration, and you will lose sight of the great underlying principle. You obtain results, but at the sacrifice of quality. I did not construct. When I got an idea, I started right away to build it up in my mind. I changed the structure, I made improvements, I experimented, and I ran the device in my mind. It is absolutely the same to me whether I place my turbine in my mind or have it in my shop actually running in my test. It makes no difference. The results are the same. In this way you see I can develop and perfect an invention without touching anything, and when I have gone so far that I have put into that device every possible improvement I can think of, that I can see no fault in it any more, I then construct it, and every time my device works as I conceived it would, my experiment comes out exactly as I plan it, and in twenty years there has not been a single, solitary experiment which did not come out exactly as I thought it would."

Mr. Tesla then related some very interesting experiences of his youth in which he had hairbreadth and almost miraculous escapes that led his parents to set him apart for the ministry. At the age of 18 during a violent epidemic of cholera he contracted the disease with several complications that made everyone despair of his recovery. "My father came, sat on my bed and said to me, 'Are you going to get well?' I said to him, 'I will get well if you will let me study engineering.' He said, 'Certainly I will, you will have to go to the best polytechnic school in Europe.' My father kept his word, and after a year of roaming through the mountains and getting myself in good physical shape, I went to the Polytechnic School at Gratz, one of the finest in Europe. * * *

"The first year at the polytechnic school was passed in this way—I got up at three o'clock in the morning and I worked until eleven o'clock at night, for one whole year, without a single day's exception. Well, you know when a man with a reasonably healthy brain works that way he must do something. Of course, I did. I graduated nine times that year and some of the professors were not satisfied with giving me the highest distinction, because they said that did not express their idea of me, and here is where I come to the rotating field. In addition to the regular graduating papers they gave me some certificates. I got these certificates and showed them to my father. I thought it would be a great triumph for him. My father took the certificates and threw them into the waste basket. He said, 'Oh, I know how these certificates are obtained.' That almost killed my ambition, and later, after my father died, I was mortified to find a pack of letters, from which I could see that there had been considerable correspondence going on between my father and the professors at the school, and the professors had written to the effect that unless he took me away from the school I would kill myself with work. Then I understood why he had slighted my success, which I was told was greater than any which had been achieved by any student before; in fact, the best students had only graduated twice, and I had graduated nine times. My work in the first year had this result—that the professors became very much interested in me and very much attached to me.

"It was in the second year of my studies that we got a gramme machine there from Paris. This was a machine with a horseshoe form of laminated magnets, and there was an armature in it with a commutator. I put that together and we connected it up and showed the various effects of currents. During this time that Professor Poeschl was demonstrating we had some trouble with the brushes. The brushes sparked very badly, and I said, 'Well, why should not we operate without the brushes?' Professor Poeschl said it could not be done, but in view of my success in the past year he gave me the honor of delivering a lecture. He said: 'Mr. Tesla may accomplish great things, but he certainly never can produce this,' and he showed that this would be tantamount to converting a steadily pulling force, like gravity, into a rotary effort, which was a sort of perpetual-motion machine, an impossible idea. * * * I showed them that I was right and it was possible. It was not a perpetual-motion idea. It was not a thing which was impossible, it could be done, and I started then to work.

"I will not tire you with an extended account of this undertaking, but I will say that my work was like this—I began in 1877 in the summer, and then I would get a picture in my mind. I would picture, for instance, a direct-current machine and run it and see how these currents changed in the armature, and whatever I imagined, I would put together and operate everything in my mind, and I continued that practice until 1882. I could not visualize just exactly how to do it, but I felt I was approaching a solution. I was on my vacation and sure enough the idea came to me. I will never forget the moment. I was walking with a friend of mine in the city park at Budapest, and I was reciting poems from Faust. It was nothing for me to recite from memory the contents of an entire book, with every word between the covers, from the first to the last, and my sister and brother had a much better memory than mine. Just as the sun was setting I felt wonderfully inspired, and the idea came to me like a flash, and I saw the whole thing clearly, I saw my generator, I saw the motor, and saw the connections, saw it work, in my mind, and I took a stick and drew on the sand the diagrams which were drawn in my paper before the American Institute of Electrical Engineers, and which were illustrated in my plans as clearly as possible, and from that time I carried this image in my mind. Now, remember, if I had been a man who had had some of the practical gifts of Edison, I would have gone right away to perform an experiment and push the invention along, but I did not need to experiment—as I say, I can so picture, and consider what I picture as real and forcible, that I do not need any experimenting, nor is it particularly interesting to me. I went on and improved the plan continuously, invented new forms, and the day before I came to America, every form, every construction, every arrangement which I expressed in my patents, was developed in my mind, except just two or three forms which appear in later developments, otherwise I had all the forms shown in the thirty or forty patents granted to me then in my mind. In 1882 I performed two experiments in Strasburg, as Mr. Terry pointed out, and there at the railroad station I obtained the first rotation.

"I have come now to an interesting point when I came to America. I had made some improvements in dynamos for a French company who were getting their machinery from America. The improved forms were so much better that the manager of the works said to me, 'You must go to America, and you must design these machines for the French company.' So, after ineffectual efforts on the other side to get somebody to interest himself in my plans financially, I came to America. * * * Then came another event. I met Edison, and the effect that Edison produced upon me was rather extraordinary. When I saw this wonderful man, who had had no training at all, no advantages, and did it all himself, and see the great results by virtue of his industry and application, I felt mortified that I had squandered my life—you see I had studied a dozen languages, I had delved in literature, and had spent the best years of my life in ruminating through libraries and reading all sorts of stuff that fell into my hands. I thought to myself, what a terrible thing it was to have wasted my life on those useless things, and if I had only come to America right then and there and devoted all of my brain power and inventiveness to my work, what could I have not done? In later life I realized I might not have produced anything without the scientific training I got, and it is a question as to whether my theory as to my possible accomplishments was correct. In Edison's works we passed a year of the most strenuous labor, and then certain people approached me with a proposition to form my own company.

"Well, I went into the proposition, and we developed an arc light, and to show you how prejudiced the people were against the alternating current, as one of the speakers indicated, I told these friends of mine I had a great invention relating to alternating-current transmission, and they said: 'No, we want the arc lamp. We don't want this alternating-current system.' Finally I brought out an arc lamp, perfected it, and the city adopted it. Then I succeeded in organizing another company, in April, 1886, and then a laboratory was put up, and then I rapidly developed these matters, and finally the Westinghouse people approached us, and an arrangement was made, and then you know what happened since then. The invention has swept the world.

"Mr. Behrend has referred to other inventions of mine. I will say just a few words, because some of my work has been misunderstood. It seems to me that I ought to tell you a few words about other efforts that have absorbed my attention later. In 1894 I delivered a lecture at the Royal Institution and Lord Raleigh surprised me by acknowledging my work in very generous terms, something that is not customary, and among other things he stated that I had really an extraordinary gift for invention. Up to that time, I can assure you, I never realized that I was an inventor at all. I looked upon the rotating-field discovery as simply a mathematical deduction. It was a logical, step by step, deduction. I forced this invention, as it were, by screws and levers. I did not get an inspiration, as it were. My machines were developed all in my mind. When I tried the first experiments they meant nothing to me. I had already demonstrated them perfectly. So when I went home, in 1892, and heard these remarks of Lord Raleigh, I began to think and said to myself, 'Why, certainly I must have been an inventor.'

"I remember that I constructed turbines and clocks and such things, and so I said to myself, 'If I really have a gift for invention, then I am going to bend it to some great purpose and some great task and not squander my efforts in small things.' I began to think just what was the greatest thing to accomplish. One day I was working in the forest and a storm came up. I ran under a tree for shelter, and the air was very heavy, and all at once there was a lightning flash, and immediately after the lightning flash a torrent of rain came. That gave me a fair start. I realized that the sun was lifting the water and vapor, and the wind swept it over the regions where it accumulated and reached the condition where at a certain point it was condensed and fell to the earth again, and this life-sustaining stream of water was entirely dominated by some other power, and lightning or some other agency of this kind, simply came in as a trigger mechanism to relieve the energy at the proper moment. I started out and attacked the problem of constructing some kind of a machine which would this kind simply came in as a trigger mechanism to relieve the enable us to precipitate this water wherever desired.* *

THE COLORADO EXPERIMENTS.

"That led me to the production of very intense electrical effects. At the same time my wireless work, which I had already begun, was exactly in that direction, and so I devoted myself to the perfection of some device, and in 1908, I filed an application describing an apparatus with which I think this wonder can be achieved. The Patent Office examiner was from Missouri, and he would not believe it could be done, and so my patent was never granted, but in Colorado I constructed apparatus by which I produced certain effects, at least, which were greater than those of lightning—I do not mean, for instance, in potential. The highest potential I reached was something like 20,000,000 volts, and that is insignificant as compared to lightning, but certain effects in my apparatus were greater than those produced by lightning. For instance, I got in my attenna currents of 1000 or 1100 amperes, and you know that in the biggest wireless plants only 250 amperes were used —I do not know what is the biggest one now—but 250 amperes is very large, and I know in Colorado I succeeded one day in precipitating a mist. Of course, there was a mist outside, but when I turned on the current the mist in the laboratory became so great that I called the attention of my assistant that when the hand was held just a few inches from the face it could not be seen, so that I am positive of my conviction that we are able to erect a plant of proper design in an arid region, that we can work this plant according to certain observations and rules, and that we can draw from the ocean unlimited amounts of water for irrigation and power purposes. If I do not live to carry it out, somebody else will, but I am sure that I am right.

"As to the transmission of power through space, that is a matter which I have considered certain, absolutely certain, years ago. Years ago I was in a position to erect a plant to transmit wireless power to any distance without limitation, other than the physical limitations of the globe. In my system it makes no difference what the distance is. The efficiency of the transmission can be as high as 96 per cent, or 97 per cent, and there is no loss except those losses which are inevitable in the running of the machinery. And when there is no receiver there is no loss anywhere. When the receiver is put on, it draws energy. That is the opposite of the Hertz wave system. In that system you have a plant of 1000 horsepower, that is 1000 horsepower radiating all the time, but if I have a plant of 1000 horsepower under my system, this only consumes the few horsepower necessary to maintain the electric vibration, and the rest of the system is idle, exactly as the Edison lamps are idle when the lamps and dynamos are shut off.

"I have made advances along this line in later years which will contribute to the practical features of the system. Recently we have obtained a patent on a transmitter with which it is practicable to transfer unlimited amounts of energy to any distance. I had a very interesting experience with Mr. Stone, whom I consider, if not the ablest, certainly one of the ablest living experts. I said to Mr. Stone: 'Did you see my patent?' He replied: 'Yes, I saw it, but I thought you were crazy.' When I explained to Mr. Stone he said: 'Now, I see why that is great,' and he understood how this energy is transmitted.

"Now, gentlemen, we are coming to great results, but we must be prepared for a condition of paralysis for quite a while. We are facing an enormous crisis such as the world has never seen before, and until the situation clears the best thing we can do is to devise some scheme for overcoming the submarines, and that is what I am doing now."

Electricity in Construction Work

Advantages of Electrically Driven Machines for Contractors and Builders—Characteristics and Horsepower Requirements—Off-Peak Possibilities of the Business

By H. O. STEWART

Industrial Engineer, Rochester (N. Y.) Railway & Light Company.

JUST as the modern merchandizing house, with its well planned selling campaigns, goes after business during the dull seasons of the year, the central station is eagerly searching for and connecting to its distribution system that most desirable kind of power load designated as "off peak." When one stops to consider that the central station's peak load very generally occurs during the hours of from four to seven in the afternoon, 25 days per month, during November, December, January, and February, or for a period of only 300 hours out of 8,760 hours per year, he must realize that power can be profitably sold at a lower rate for utilization outside of these peak hours. This is due to the fact that the central station's cost of power delivered to the consumer consists largely of fixed or overhead expense, which is nearly proportional to the magnitude of the winter peak load. However, as it is not practical to reduce the winter peak, the most profitable thing to do is to go after and obtain those power loads which can be made off peak, or what is still better, those power loads which are naturally off peak. The advantage of the latter over the former load is that in times of great business prosperity it is not so liable to coincide with the central station's peak load as the former.

Outdoor construction work is, in general, carried on only during daylight hours throughout the year, although on large jobs the work is sometimes prosecuted from 16 to 24 hours per day during the summer and part of the spring and fall. This is a most desirable load from the central station's point of view. (By outdoor construction work is meant such undertakings as excavations for waterways or other means of transportation, for tunnels and buildings; erection of buildings and various structures; and handling and placing of concrete.) The construction company or contractor, on the other hand, is usually very glad to be able to purchase electricity to operate his machinery, as it lowers his costs, eliminates most of his shutdowns and speeds up his work.

Although internal-combustion engines have been used to some extent, especially on small contracts, electricity or steam is almost always used on large or important work. During the last five years the electric motor has made a most decisive inroad into the former field of steam-operated machinery, with the result that today in many localities the contractors' equipment is entirely motor operated.

Advantages of Motor-Driven Machines.

This rapid change has been brought about by the central-station men who convinced the most skeptical that electric power for the operation of this type of machinery, in general, cost less, was more convenient and flexible, was cleaner, and more reliable and safer than any other kind of power.

To bring this about, it was necessary for these central-

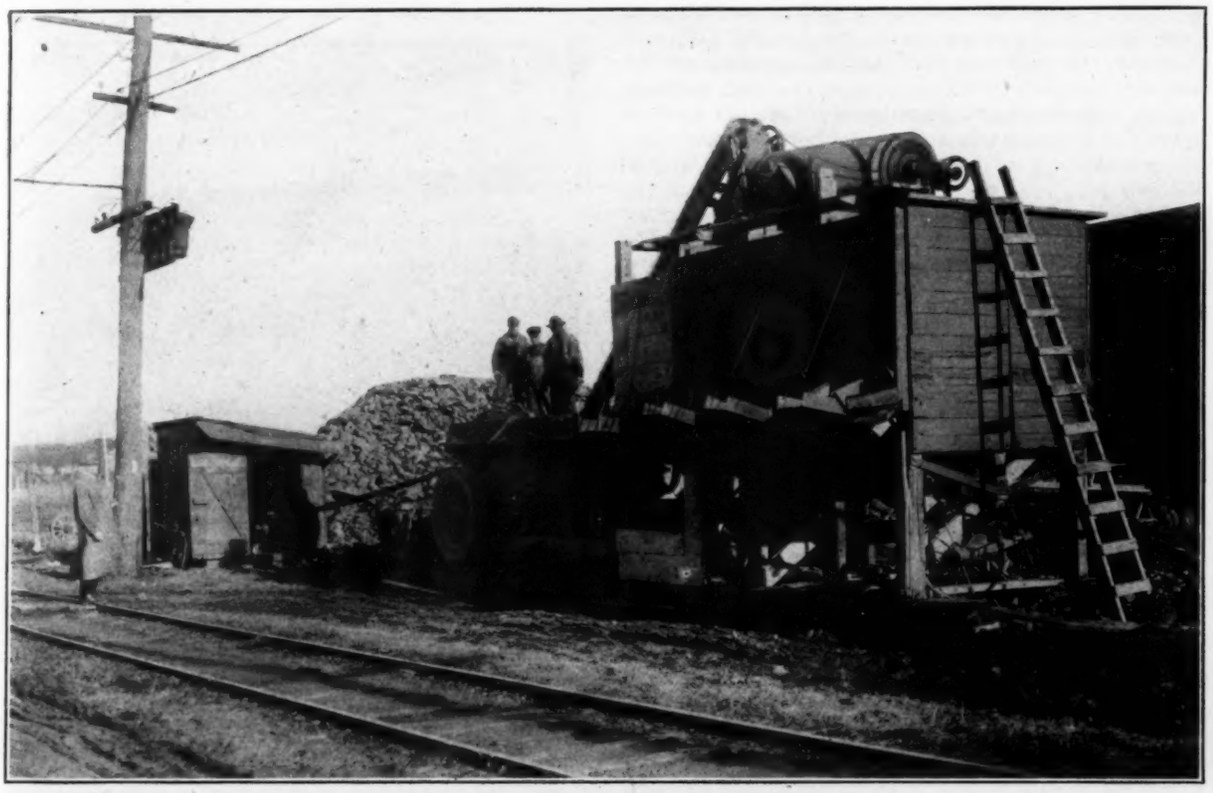


Fig. 1.—Motor-Operated Portable Jaw Crusher and Screen.

station men to become acquainted in a general way with the various machines on the market to the extent of knowing what these machines were built to do and how they should be operated. This information was obtained by observation and in conference with the contractors and manufacturers. Numerous tests were run on steam-operated machines to determine the actual horsepower required and the operating costs. Trial motor installations were made to obtain oper-

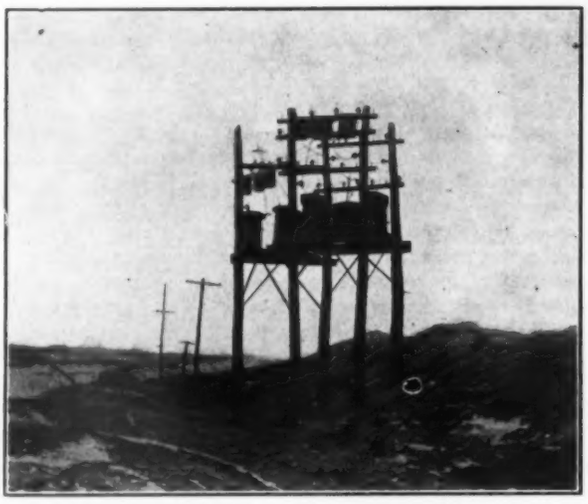


Fig. 2.—Framework for Bank of Transformers.

ating cost data and convince the contractors of the many advantages of electric motor drive. It was found that the speed regulation of steam equipment was poor and the maintenance cost high. Speed requirements were met with motors of ample capacity and proper operating characteristics. High maintenance cost was due in some cases to frequent moving and unskilled attendants, in other instances to lack of periodic adjustment and overhauling, to overloads and faulty installation. Maintenance cost was greatly reduced with motor drive, as the motors selected were very rugged, had plenty of capacity for overloads, were properly installed, and the attendants were instructed as to their care and operation. Periodic inspection by the central-station man was found to be most desirable to insure first class operation and eliminate prejudice. This, however, was necessary for a short time only.

The impossibility of supplying a suitable kind of water for the boilers was often the cause of serious boiler trouble and sometimes necessitated the renewal of the tubes as often as once a year. In cold weather the supply piping occasionally froze and the machinery stopped.

The coal supply is an important item. Recently coal has been very expensive and difficult to obtain at any price. Coal fired is always less than coal purchased. To supply a steam shovel making a deep cut the following method of coal handling is often used. The coal is dumped from the car onto the ground. It is then carted along the top of the bank and dumped so as to slide down the slope near the rear of the shovel, after which it is placed in nail kegs and carried to the boiler. A consequent loss of 25 per cent would be conservative.

Steam-operated machinery requires skilled labor. Such machines as pumps, stone crushers, and concrete mixers need no labor for their operation when motor driven. The lack of engineers or firemen will tie up a job using steam. It should be remembered that in freezing weather it is either necessary to draw the fires and remove all water from steam equipment each night or else keep a fireman on duty. The latter course is safer and is usually followed. Starting and stopping electrically operated machines is so simple that their operation is not dependent on the presence of any one or group of individuals. In other words, an electric motor requires no skilled or constant attendant.

Smoke, soot, noise and sparks from steam machinery have caused so much complaint in cities that it is not unusual to find in the specifications for certain work a statement that the contractor is to drive his machinery electrically.

In order to be portable, the steam machine must be mounted on a truck and self contained, that is, the engine, boiler, water tank, and coal bin should all be on a common base. Compare a portable motor-driven hoist, pump, saw, mixer or rock drill with a steam one. The electric output is more compact, lighter and easily supplied with power. The low-voltage wires can be supported on portable tripods or laid on the ground. The wires are placed in flexible conduit if liable to injury. For short runs which will be used only a limited time, double-braided rubber-covered wire can be laid on the ground, provided it will not be subject to abrasion or injury. The steam equipment has to be followed with a water pipe and coal wagon.

Particular study should be given to keeping the cost of wiring and installation as low as is possible with safety and reliability. Looks do not count. Open wiring can generally be used. Close voltage regulation is seldom necessary. Fig. 2 shows how the framework for a second bank of transformers was supported by the addition of only one pole. The details of the picture show a rugged installation at low first cost, and a doubling of the capacity.

Types of Motors To Use.

The squirrel-cage induction motor and the direct-current shunt motor are most commonly used on outdoor construction work. For high starting torque, the slip-ring induction motor and the direct-current compound-wound motor are generally required, but should not be used except when necessary. Series motors should be used only with great caution, as their high speeds at light loads are apt to cause serious trouble. Low-voltage motors are most desirable for this class of work, as motors occasionally will develop grounds which make all metals alive to which they are electrically

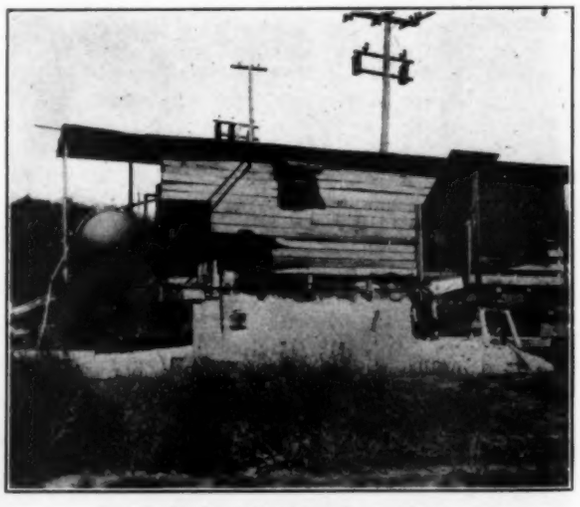


Fig. 3.—Portable Compressor Plant.

connected. A voltage of not more than 230 volts is advisable where most of the motors are under 60 horsepower capacity. For large stationary motors, higher voltages can be used to advantage if the installation is carefully made and guarded.

The motors themselves should be strongly built and not affected by a fair amount of moisture, dirt or vibration. The bearings should be of generous size, dust proof and equipped with ample oil reservoirs. The windings should be so placed as to be protected from external injury. Inclosing end shields

should be used in wet and dirty places and where flying objects might injure the windings.

The mechanical connection between motor and machine is so essential for successful operation that it should always be given careful study. For direct-connection a flexible coupling is desirable, as machines will get out of line and are left out of line. Sometimes it is desirable to either install a friction clutch or a coupling with bolts which will shear off in case the machine is suddenly stalled. Such a connection is often made on the cutter drive of a suction dredge.

Gear and chain drives should be protected so that such things as stones and bolts cannot fall into the gears and tear out the teeth.

Belt drives should be very liberally designed. On account of lack of attention, water, dirt and probable overloads —large pulleys, high belt speeds and plenty of belt cross-section are advisable. Rubber belts should be used in wet or dirty places. Otherwise leather belting is desirable. If possible, belts should be made endless. At any rate, metal connectors or any other materials used to splice a belt, which pound on the pulleys, should be avoided, as they cause bearing trouble. The top side of the belt drive should be the loose side. Where there is insufficient driving surface on the smaller pulley, an idler pulley should be placed on the slack side of the belt close to the smaller pulley—thereby greatly increasing the power-transmitting capacity of the belt.

Should Have Stock Available for Renting.

Most central stations have some of this kind of power business. One of the most effective ways of building up this load is to have available for rental a fair stock of motors and a few electric hoists, centrifugal pumps and concrete mixers. This equipment should be placed on work where it will gain as much publicity as possible. It will be found that many contractors think they cannot afford to buy electrical equipment but will gladly rent it.

The motor stock need not have all sizes and speeds. A smaller number of selected sizes of slow-speed motors is to be preferred. Two, five, ten, twenty and thirty-horsepower motors are all that are required up to 30 horsepower. A load

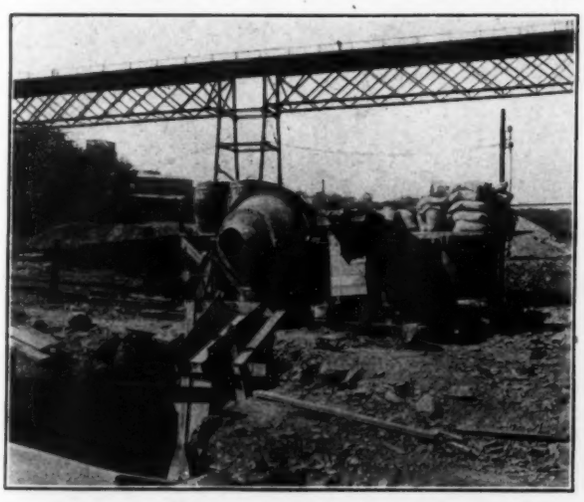


Fig. 5.—Stationary Concrete-Mixing Plant.

which is so small that it cannot be operated with a two-horsepower motor is hardly worth securing. Larger motors should also be kept in stock, the upper limit depending on local requirements.

The rental charge should consist of two parts. One part should be a flat charge to cover the cost of overhauling and returning to stock equipment which has been out on rental. This charge is independent of the number of days the equipment has been in use and protects the company from loss in case the apparatus has only been in use a few days. The other part of the rental charge should be a flat rate of a fixed amount per day or month. This charge should be a percentage of the first cost. The rental charge should cover the cost of interest, depreciation, insurance, storehouse expense, repairs not charged to customer and a fair profit.

A very successful method of obtaining large power business is to have on hand a fair list of large motors, air compressors and various kinds of machinery which a contractor starting a large job might need. An offer to locate such

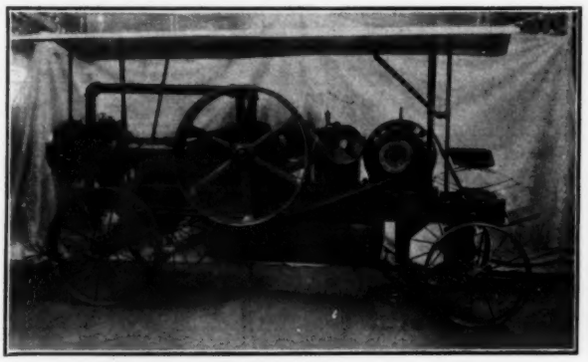


Fig. 4.—Portable Motor-Driven Compressor.

equipment for him and obtain prices usually results in an electric contract.

In order to bring out some of the general points which should be understood by those undertaking to obtain this kind of power load, and, at the same time, to show some of the difficulties involved, specific types of machinery will be considered. Rock crushing machinery will be first taken up.

Characteristics of Rock Crushers.

A rock crusher is probably as severe a power load as any machine operating continuously. The small steam engines have such a hard and expensive time driving rock crushers that it is very easy to eliminate all of them in a given territory after a satisfactory motor installation has been made.

In order to convince a contractor that his rock crusher could be operated cheaper with electric power a careful all-day test was made on his steam-operated crusher. The coal was weighed. The feed water was measured by a cold-water meter. The engine was indicated. The following data were obtained:

Actual hours operation	7.1	hours
Coal fired during day	1,258	lbs.
Coal used for banking	58	lbs.
Boiler feed water	6,672	lbs.
Crusher running light	8.2	horsepower
Average load	15.7	horsepower
Maximum load	19.8	horsepower
Stone crushed	50	tons

Results:

Horsepower-hours during test	75
Pounds of steam per horsepower-hour	89
Pounds of water evaporated per pound of coal	5.3
Pounds of coal per horsepower-hour	16.8
Kilowatt-hours per ton of rock crushed	1.1

The cost of operation by steam was as follows:

Labor	$3.50
Coal, 1,316 lbs. @ $3.10 per ton	2.04
Water, 6,672 lbs. @ $1.05 per 1,000 cu. ft.	.11
Repairs and supplies (estimated on the basis of the cost per year)	.75
	$6.40

As this steam power actually cost more than 10 cents per kilowatt-hour, it was not difficult for the power salesman to show a remarkable saving when he installed a motor drive on this crusher.

Gyratory and jaw crushers are in common use, although the latter is the one more frequently used by the contractor on account of it being portable. The average jaw-crusher plant, as shown in Fig. 1, consists of a portable crusher and screening plant. The screening plant consists of an elevator,

revolving screen and bin for rock storage. The screen and elevator are belted to the crusher shaft. The motor is belted to crusher flywheel. The flywheel speed should be either 300 or 150 revolutions per minute, according to whether the crusher is respectively single or double acting. Pulley centers of at least 30 feet are to be recommended to minimize the shocks on the motor and to keep it away from the worst of the dust. The horsepower required depends on the kind

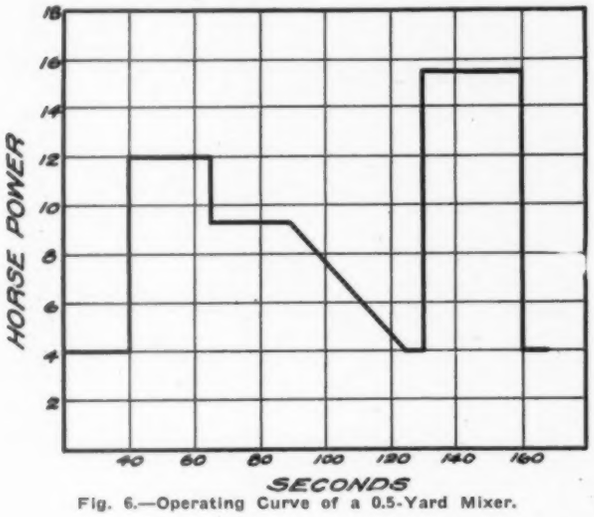


Fig. 6.—Operating Curve of a 0.5-Yard Mixer.

of rock, size of rock fed, size of stone discharged from crusher and quantity of rock supplied to the crusher. A test of a motor driving a rock crusher showed that the motor had an output of 22 horsepower when the machine was fed by two men and that the motor input increased to 34 horsepower with three men feeding the crusher.

Jaw crushers are usually rated according to the size of opening or receiving capacity of the jaws in inches. For average conditions allow one horsepower of motor capacity for each six square inches of opening. The capacity per hour in tons of rock crushed will equal about one-half the horsepower of the motor as above obtained. As an example, a crusher with a jaw opening of 10 by 18 inches, or 180 square inches, will require a 30-horsepower motor and will crush 15 tons of rock per hour. The kilowatt-hours used per ton of rock crushed varies widely, as is made apparent in the following table:

50-h.p. motor,	0.94 k.w.h. per ton	limestone
75-h.p. motor,	0.34 k.w.h per ton	shale
67-h.p. motor,	0.75 k.w.h. per ton	limestone
25-h.p. motor,	1.2 k.w.h. per ton	limestone
25-h.p. motor,	2.0 k.w.h. per ton	limestone

Motor Drive for Air Compressors.

Compressed air is in quite common use on most outdoor construction work. On rock cuts it is used for operating various types of rock drills and channeling machines. Where water pipe is being laid, it is first used for drilling the rock in the trench; secondly, for chipping, caulking or riveting the pipe; then for testing the pipe under pressure, and finally for operating tamping tools. The erection of steel requires considerable compressed air for riveting and chipping. Quantities of concrete have been transported considerable distances through pipes by means of compressed air. The so-called cement gun, used for coating surfaces with concrete, uses a large quantity of compressed air. For rock-tunnel work, compressed air is most desirable from the standpoint of supplying fresh air to the workmen.

The average 3.25-inch tripod drill requires about 100 cubic feet of free air per minute when in good condition. When in poor shape, it is liable to take twice as much air and have a much smaller hourly footage. The newer types of drills, such as the jack-hammer and the water-liner, are much more efficient. The jack-hammer drill is used without a tripod, takes from 60 to 75 cubic feet of free air per minute—generally nearer the latter figure, cuts a hole of sufficient size for ordinary purposes, and is now in common use by progressive contractors. The water-liner drill is used in connection with a tripod or column. Water is forced through the hollow drill steel into the hole. This drill requires from 75 cubic feet of free air per minute upwards, according to its size. The wagon type of drill uses 350 cubic feet of free air per minute.

Steam-operated drills are seldom used except on small jobs where only one or two drills are needed. Portable boilers will often be found on this class of work. Unless the boiler is kept quite close to the drills, there is such a large pressure drop and so much condensation in the piping that the drills will not operate satisfactorily. Ten boiler-horsepower is required for the ordinary 3.25-inch tripod drill when in good condition. The wagon type of drill requires 35 boiler-horsepower.

In general, steam drills are more difficult to move than air drills. Drill runners object to the heat in hot weather and the cloud of moisture in cold weather. Steam hose has very short life and is a large item of expense. Air-operated drills have from 10 to 20 per cent greater footage.

Motor and steam-driven air compressors are both used, although the former is much more commonly seen. Either source of power may be direct-connected or belted to the compressor. Single-stage compressors of from 200 to 300 cubic feet capacity require approximately 15 horsepower per 100 cubic feet of free air compressed to 80 pounds pressure. Two-stage compressors of from 800 to 1,200 cubic feet capacity require about 12 horsepower per 100 cubic feet of free air compressed to 100 pounds pressure and three-stage compressors 10 horsepower. Where there are a number of drills in use, the connected load can generally be greater than the rating of the compressor, as all the drills would almost never be actually cutting at the same time.

The speed of an air compressor is limited by the opening

Fig. 7.—Converted Steam-Driven Mixer.

and closing of the valves. While many of the older types run as slow as 150 revolutions per minute, the late models, even in large sizes, run as fast as 250 revolutions per minute. The larger sizes are often direct-connected. Belt drives with short pulley centers and idlers are very satisfactory on account of the large wrap of the belt around the motor pulley and the comparatively loose belt. Motors with high starting torque are the most suitable, although the starting load is usually greatly decreased by fastening the unloader in the open position. The water used for cooling the compressor should not be thrown away, but should be utilized somewhere on the job

either for concrete or for boiler-feed water for those machines which cannot be motor driven.

Comparatively large motor-driven compressors are now mounted on flat cars so that they can be moved along a rock cut of several miles in length as the excavation progresses. In excessively long air lines the pressure cannot be maintained and the cost of the power line is less than that of the air line. Fig. 3 shows a portable compressor plant consisting of a 900-cubic-feet-per-minute compressor, air receiver, 200-horsepower induction motor and transformers.

Smaller portable motor-driven compressors, such as shown in Fig. 4, are used for trench and quarry work.

In order to prove to a contractor that his air compressors should be electrically operated instead of steam driven, it is sometimes necessary to draw up a comparative cost balance sheet. The following items should be considered: Interest on investment, depreciation, insurance, coal, labor, repairs and supplies, water and electricity.

The cost of the steam-engine compressor is roughly equal to that of the motor-driven compressor. Additional investment is required for the boiler plant with its feed-water pumps, heater, stack and building. Liability and boiler insurance should be included. In addition to the coal actually fired when running, about 0.5 pound of coal per boiler-horsepower-hour will be required for banking and firing up.

Steam-operated air-compressor plants of from about 700 cubic feet capacity and upwards require at least one engineer and one fireman per shift.

Concrete Mixers.

In all central-station territory there are a number of concrete mixers which either are or should be motor driven. Stationary concrete mixing plants are usually belt driven if of small capacity, as shown in Fig. 5. The larger plants are generally gear driven. Fig. 6 shows a time study of a 0.5-yard mixer and a one-ton hoist. The curve shows the cycle of operations to have been as follows: Mixer ran light for 40 seconds; 25 seconds were consumed in raising charging hopper; concrete was mixed for 30 seconds; 30 seconds were required to dump mixer into bucket; 5 seconds were wasted in starting hoist, and 30 seconds were required to elevate load of concrete to top of pouring tower. The curve shows the horsepower as well as the time required for each step in the process.

An efficient cycle of operation would be as follows: Charging mixer, 10 seconds; mixing concrete, 20 seconds, and discharging mixer, 10 seconds.

The power requirements of concrete mixers vary somewhat according to the design. The motor horsepower for mixers under two-thirds yard capacity is installed on the basis of one horsepower for every two cubic feet of mixer capacity. This capacity is in terms of dry and loose material. The power required for larger mixers is somewhat less.

Fig. 7 shows how a steam-driven mixer was changed to electric drive. The boiler and the engine connecting rod were first removed. A large gear was substituted for the flywheel. A five-horsepower motor was fastened to the truck and connected to the gear with a small pinion. The motor was controlled by the three-pole switch at the end of the truck and supplied with power through wires in flexible conduit laid on the ground.

Motor Drive for Hoisting Machines.

On almost every construction job will be found some kind of hoisting or pulling mechanism which, in general, consists of a power-driven drum on which the hoisting or pulling cable is wound. These hoists vary in size from the self-contained one-horsepower motor-driven type which is hung from a tripod over a pit to the large hoisting and traveling machines equipped with a number of motors of several hundred horsepower capacity.

Although small hoists use very little electricity, they are often the entering wedge for motor-operated machinery which consume considerable power. In case an electric hoist is not available, the ordinary steam hoist can be motor driven by gearing the motor to the main shaft and fastening the motor to the hoist frame by means of brackets. A new shaft is usually necessary to provide room for the gear.

Particular care should be given to the selection of the right motor in each case. The motor torque which will be necessary to start the load as well as for the running requirements should be calculated or measured. The mechanical efficiency of the hoist mechanism is usually about 50 per cent. Fig. 8 shows a double-drum electric hoist with a capacity of lifting on either line a two-ton load at a speed of 300 feet per minute.

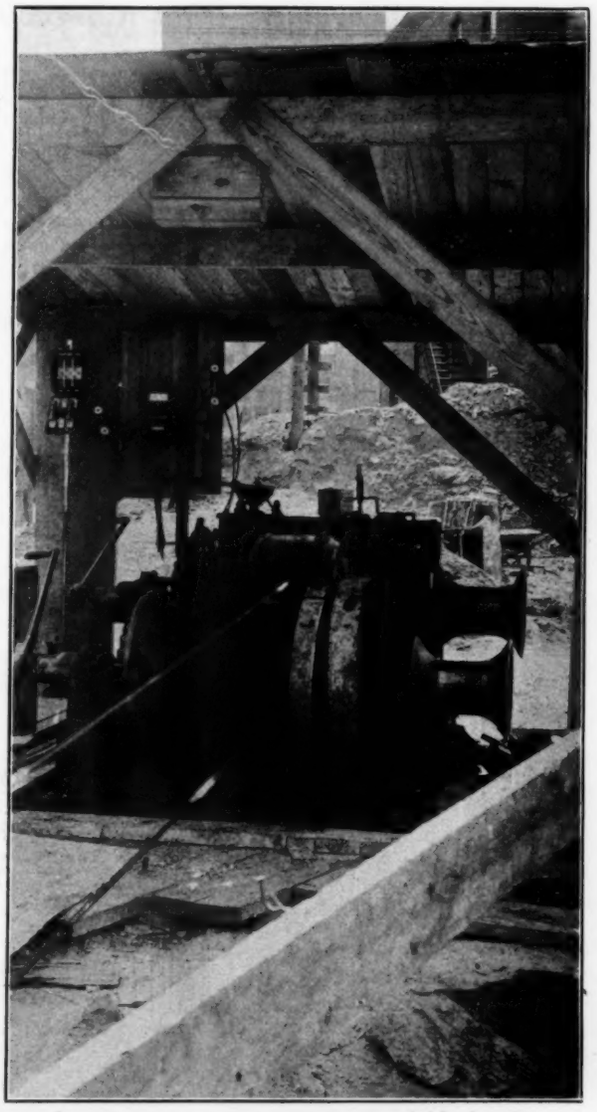


Fig. 8.—Double-Drum Electric Hoist.

One of the most severe uses to which a hoist can be put is that of pile driving. A single-drum electric hoist having a capacity of one ton at a speed of 150 feet per minute was placed on a job after three steam hoists had failed to stand the racket. Seventy-five piles were driven, each 20 feet long and 12 inches in diameter. The actual time of driving each pile was 10 minutes. The average kilowatt-hours per pile was 2.27.

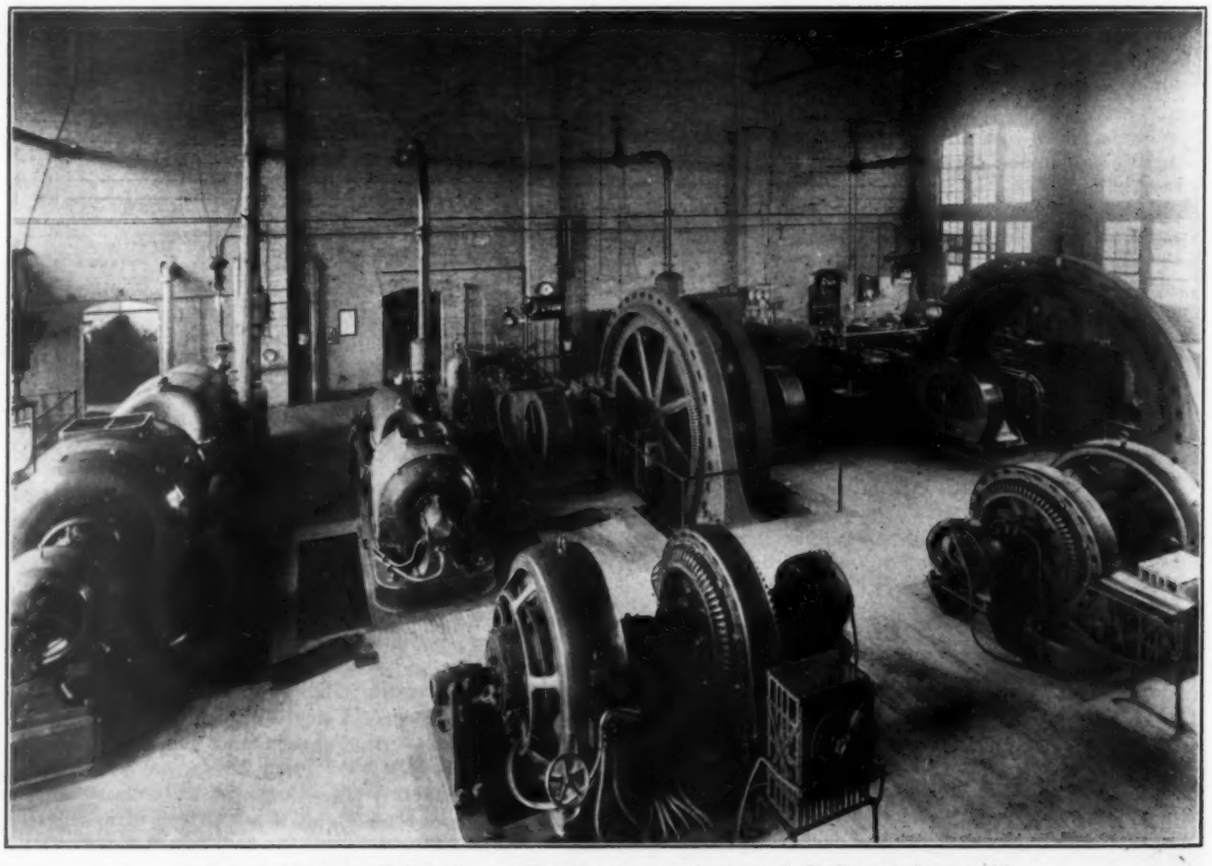
Operating Features of 3200-Kilowatt Central Station

Description of the Western United Gas & Electric Company's Steam Power Station in Aurora, Ill., Together With Characteristic Operating Features

THE electric power plant, designed according to modern practice, involves but comparatively few problems from an operating standpoint. The class and requirements of the service to be demanded, as well as provisions for extensions, are all provided for in the original plans and there seldom is need for deviation from them. Despite the rapid advances made in central-station practice, during recent years, equipment for different classes of service is reaching a more stable state of standardization, thus eliminating to a great extent the changes in operating practice that were so frequently occurred in the early development of central-station equipment.

In contrast to the power plant built within the last few years is the plant erected some 15 or more years ago, when central-station equipment and operation had not developed to such an extent as at the present time. While the service given by these plants is, in most cases, just as good, there are a greater number of problems to be confronted in connection not only with operation but with providing for extensions of service. Modern demands, involving the development and broadening of the use of current-consuming devices, have necessitated many changes in operating practice. Added to this are improved and new devices for central-station operation which recommend themselves for installation and replacement of older equipment because they afford simplification and lower operation costs. Just what limits to which the central-station company may go in junking old equipment for replacement with modern machinery are determined by the character of the service demanded and the net revenue received. Usually it is a case of making the best of what equipment there is, and keeping the operation as modern as possible—which fact accounts for the additional operating problems.

A typical illustration of the modernizing of a comparatively old central-station is found in that of the Western United Gas & Electric Company at Aurora, Ill. When this plant was first built, some 15 years ago, the first generating units to be installed were of the engine-driven type, and provision was made for increasing the capacity of the station by the installation of additional units of the same type. Energy was generated at 2,200 volts, two-phase, 60-cycle, which was according to accepted practice at that time. However, the plan of adding more engine-driven units was changed by the introduction of turbogenerators, and the company exhibited its appreciation of the advantages of this type of generating equipment by installing one of the first horizontal



View in Western United Gas & Electric Company's Central Station at Aurora, Ill.

turbogenerators to be manufactured in this country as the third unit in its station. More recently two additional units of the same type were installed. No change in the character of the energy generated was made. From a station operating standpoint this is entirely satisfactory, though it involves more than the usual number of problems from a service operating standpoint.

These problems have been successfully solved, most of them being occasioned by a demand for three-phase current for motor operation, which was accentuated by a change in the character of the load from a large demand for energy for lighting to one for power. This condition was brought about by the rapid growth of Aurora as an industrial center, which was not foreseen when the original plans for the station were made. Other service problems met and solved were caused by the company's activities in extending its lines to neighboring communities, these involving questions of transmission and transformation of energy for secondary distribution to suit the demands of customers in small town and in the rural districts.

In order to give a better understanding of the operating characteristics a description of the equipment of the plant is first given.

Generating Equipment.

The first units to be placed in operation in the station were installed during 1903 and 1904 and consisted of one 500-kilowatt and one 200-kilowatt, two-phase, 60-cycle, 2,300-volt National generator direct-connected to Hamilton Corliss cross-compound engines running at 100 revolutions per minute.

During the latter part of 1906 the company installed a 500-kilowatt Allis-Chalmers turbogenerator. This machine generates energy at 2,300 volts, two-phase, 60-cycle, and runs at 3,600 revolutions per minute. In 1909 a 1,000-kilowatt and in 1913 another 1,000-kilowatt Allis-Chalmers turbogenerator were installed, both generating at 2,300 volts, two-phase, 60-cycle, the former running at 1,800 and the latter at 3,600 revolutions per minute.

In 1904 the company installed a 2,200-volt, National synchronous motor direct-connected to a 250-kilowatt, 500-volt, direct-current generator. This machine supplies power for a direct-current factory load, and the field of the synchronous motor is overexcited to obtain a station unity power-factor. It is started by means of series motor which obtains its power from the 125-volt, direct-current exciters.

All of the exciter units operate at 125 volts and are connected to a common bus at the switchboard. They consist of one 50-kilowatt engine-driven unit, a 50-kilowatt unit direct-connected to a 2,200-volt, two-phase synchronous motor, and a 50-kilowatt unit driven from the main shaft of the 1,800-revolutions-per-minute turbogenerator.

Boiler and Condensing Equipment.

The first installation included four 250-horsepower class "A" Sterling boilers with hand-fired grates. Later two 400-horsepower class "S" Sterling boilers equipped with Model stokers were installed and the four original boilers were equipped with stokers at this time. About three years ago two 500-horsepower class "O" Sterling boilers were installed, these being operated with Martin grates. These two boilers will be equipped with stokers later. On account of the steam heating load carried in the winter additional boiler capacity was necessary, but because the two boilers are not used in the summer their use did not warrant the investment in stoker equipment. When the increases in the power load necessitate the use of the two boilers, stokers for these boilers will be added to the present equipment.

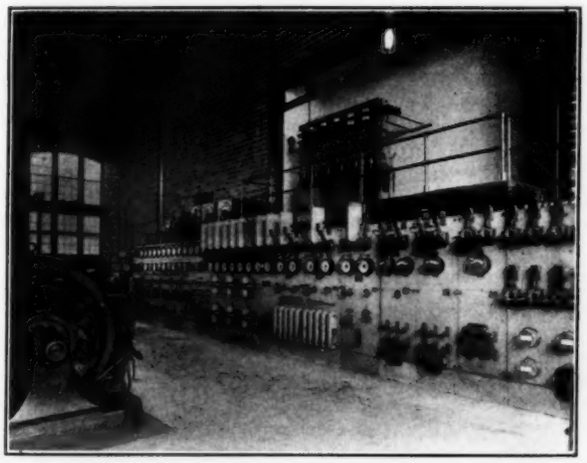
The two engine units exhaust into Worthington barometric jet condensers or by means of valves may be made to exhaust into the steam heating system either singly or doubly, though it is not arranged so one engine can exhaust into the condenser while the other engine is exhausting into the heating system.

The 500-kilowatt turbines and the oldest 1,000-kilowatt turbine are equipped with Tomlinson jet condensers with American Ball engines driving Connersville cycloidal removal pumps. The other 1,000-kilowatt turbine has a Wheeler jet condenser, with a Tieson air pump driven by an Allis-Chalmers impulse turbine.

Operation of Steam Heating System.

A unique feature in connection with the method of operating the steam heating system is worthy of description in detail. The company carries a heating load rated at approximately 125,000 square feet of radiating surface. Most of this steam is supplied from the exhaust of the two engines which drive the 200 and 500-kilowatt generating units. Either or both engines may be made to exhaust into the heating system, the pressure being about five pounds per square inch, and live steam is admitted through a reducing valve to maintain an even pressure and to provide for large demands on the system.

The operating feature is that the engine-driven units are loaded just enough to supply the demands on the heating system. If the demand is small, only the 200-kilowatt unit is operated, while, if the demand increases, the 500-kilowatt unit or both units may be placed in operation. Ordinarily the 500-kilowatt unit, supplemented by live steam, supplies the requirements of the heating load. However, during the cold periods both the 500-kilowatt and 200-kilowatt units are operated to provide enough steam for satisfactory operation of the system. In cases of peak electric load, it is possible to run both engines condensing to secure greater electrical output, shutting off the supply to the heating system for the short peak periods. The sizes of the units and the flexibility of operation enables convenient operation with attendant economies.



Switchboards in Aurora Plant, Showing Part of the Feeder Panels on the New Gallery.

Switchboard and Feeder Equipment.

The accompanying illustration shows the switchboard as originally installed, together with additions that have been made from time to time, and also shows switchboard equipment installed in a gallery recently built. When the old switchboard was placed in service the wiring for connections was placed in a trench back of the board and the outgoing circuits were led through a cupola on the roof of the building directly over the back of the switchboard. Additions to the generating equipment and service lines resulted in objections to this method of wiring and caring for the feeder cir-

cuits, and a few years ago plans were made for simplifying the switchboard equipments and the arrangement of the outgoing circuits.

A feeder-circuit tower (shown in one of the illustrations) was erected outside of the main building and the feeders were run from the switchboard through a basement vault connecting the two points. The switchboard gallery was built, on which was installed six of the feeder panels, provision being made for additional panels to ultimately care for all of the feeder circuit. This change permitted removal of switchboard wiring from the trench, simplifying connections and disposing of considerable hazard that might be occasioned by short-circuits and burnouts.

In bringing the feeder circuits through the vault and tower to the pole lines a novel and clever scheme was used. From the panelboards the feeder wires drop directly to the basement, where there is installed a pipe rack system for supporting them. These racks are arranged so that the circuits on both of the two pole lines that leave the station may easily be identified clear to the switchboard. An idea of how this is accomplished may be gained by referring to the illustration which gives a view of the feeder wires from a point at the bottom of the tower. The rack system virtually amounts to a continuation of the pole line to the switchboard, pin positions being maintained so that it is an easy matter to identify the different circuits.

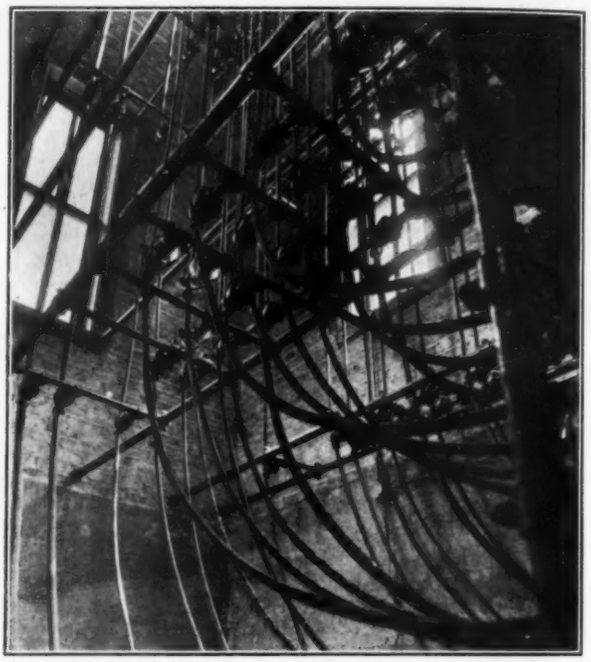
Operation of Feeder Circuits.

When the station was first built, the service demands indicated that two-phase generation at a voltage permitting economical distribution over fairly long lines would be the most satisfactory. Accordingly, the 2,300-volt, two-phase alternators were installed, and this voltage was used for primary distribution. The greater part of the load at first consisted of lamps, operating at the customary 110 volts. Later, there was some three-wire secondary distribution at 110/220 volts for light and power, and some 440-volt secondary in-

Power Plant, Showing Tower for Bringing Out Feeder Lines.

stallations have been made in recent years for supplying energy for power.

During the years that followed, line extensions were frequently made and a very comprehensive distribution system extending throughout Aurora and adjacent territory was erected. In recent years, however, the character of the load has changed materially, owing to the demand for power caused by the establishment of numerous industrial plants in and near the city. The effect of this change of load has been to present new problems in the operation of the station. The popularity of three-phase induction motors for factory drives



View in Feeder-Line Tower, Showing Arrangement of Conductors.

has resulted in a number of installations of Scott-connected transformers to convert the two-phase primary current to three-phase secondary current for power and light.

The necessity of furnishing three-phase current from two-phase distribution lines has led the company to consider another method of distribution for some of its lines. It is proposed to install Scott-connected transformers of sufficient capacity at the station, converting the energy to 13,200 volts, three-phase, for transmission, with secondary distribution at two or three phases as required on the different customers' premises. This method permits replacing the heavy line wire used for two-phase transmission with smaller gauge wire for three-phase transmission. In one installation contemplated, for instance, eight No. 2 B. & S. gauge wires will be replaced with three No. 4 B. & S. gauge wires. The saving in line investment and the reduction in transmission losses will more than cover the investment and charges on the transformer installation.

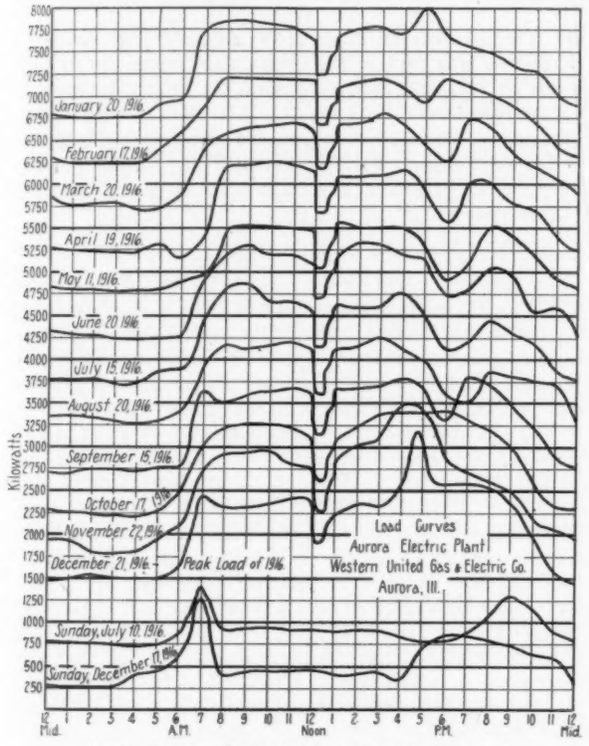
Points in Connection With Residence Service.

For making service installation for residence consumers it was the practice of the company to provide a 1-kilowatt or 1.5-kilowatt transformer. A large number of these installations were made, resulting in a considerable amount of transformer losses and maintenance expense, the latter being caused b yservice interruptions as a result of lightning and other causes. As the territory served developed the number of these transformers increased accordingly, and it was decided to make the installation of single transformers to serve a number of consumers. These group installations vary from 10 to 65 customers and the transformers are from 7 to 10 kilowatts in capacity. Distribution is at 110/220 volts, three-wire, with the neutral wire grounded to the water mains. A lightning arrester is installed on the transformer pole and in most cases

is also grounded to the water main a span or two away from the neutral-wire ground. The secondary wires are run as far as 1,000 feet for service installations. There is, of course, a notable decrease in transformer losses because of this method, and service interruptions are reduced greatly.

TRANSFORMER CAPACITIES ON GROUP INSTALLATIONS.

It was expected that the peak load on these group service installations would occur possibly on Tuesday morning when there would be a large number of electric flatirons in use, and the company was at a loss to determine just what capacity of transformers would prove adequate. Tests were made



Load Curves Plotted in a Unique Manner.

The above curves show in a comprehensive way the load conditions in the Western United Gas & Electric Company's power plant in Aurora during 1916. Each curve shows the load on a fairly average day of the month in which it was taken, the exceptions being that of May 11, showing one of the lightest loads of the year, and that of December 21, on which day the heaviest load and highest peak occurred. The lower two curves show Sunday loads, giving average Sunday conditions for the summer and winter seasons. The peak load of December 21 is typical of the season when the power load laps into the lighting load.

The method of plotting these curves is novel. The base lines of the different curves are the heavy lines, which are 500 kilowatts apart in the scale of ordinates. Thus, the base line for the curve of January 20 is at 6500, that of February 17 at 6000, and so on.

A study of the curves reveals some interesting characteristics of the load, which is mostly for commercial and residence purposes, the company supplying but little energy for street light and none for electric railways. The curve for October 17 is noteworthy because of its flatness during the afternoon hours, the lighting load increasing in the same proportion as the power load decreased.

on three group installations, one of 65 customers, one of 27 and one of 24, with a curve-drawing ammeter. It was found that the peak load occurred between 6 and 6:30 p. m. in the winter months and that the group maximum demand was about 110 watts per customer, this demand being at that figure for the three different groups. It was smaller than expected, but was accounted for because the diversity of the load was greater than anticipated. The customers were of the fairly well-to-do class, many of them being mechanics owning their own homes. Transformer capacities for these group installations are now arrived at by allowing a demand of 125 watts per customer.

EXTENSION TO C., M. & ST. PAUL RAILWAY ELECTRIFICATION PROGRESSING.

Work Started on 217-Mile Division on May 16 and Is Being Rapidly Prosecuted—Power to Be Purchased.

That part of the Chicago, Milwaukee & St. Paul Railroad between Harlowton, Mont., and Avery, Idaho, a distance of 437 miles, is now being operated as an electric line. Electric power is supplied by various plants of the Montana Power Company, the largest two of these being at Great Falls, Mont., and Thompson Falls, Idaho. The first electric train was moved in December, 1915, and the last steam-operated train was taken off the Missoula division in February, 1917. On that division is the St. Paul Pass tunnel, which cuts through the summit of the Bitter Root mountain range near the Montana-Idaho line, and has a length of 8,000 ft. This was concrete lined throughout before the line through it was electrified.

The work of electrifying another division, of 217 miles, began about May 16, 1917. The starting point is at Othello, 100 miles east of Cle Elum, and electrification will proceed westerly to Seattle and Tacoma. The character of construction will be the same as that on the Rocky Mountain division. There will be eight substations, at Taunton, Doris, Kittitas, Cle Elum, Hyak, Cedar Falls, Renton and Tacoma. Power will be furnished by the Intermountain Power Company. It is figured that the work will be completed between Cle Elum and Seattle and Tacoma before the close of 1918. This work is in direct charge of R. Beeuwkes, electrical engineer.

NEW OFFICERS OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Announcement of Election at Annual Meeting Held in New York City.

Reference to the thirty-third annual meeting of the American Institute of Electrical Engineers, which was held in New York City on the evening of May 18, is given in another portion of this issue, the main feature being the presentation of the Edison Medal to Nikola Tesla. The business matters coming up at the annual meeting consisted, first, of the report of the board of directors for the fiscal year ended April 30. This reviewed the activities of the Institute for the year and gave a financial statement of income and expenditures. The total membership as of that date was 8,170, a net increase during the year of 498.

The report of the letter ballot on the election of officers was made. The directors' nominees were elected by a large majority, as follows:

President, E. W. Rice, Jr., Schenectady, N. Y.

Vice-presidents, Frederick Bedell, Ithaca, N. Y.; John H. Finney, Washington, D. C.; A. S. McAllister, New York City.

Managers, Walter A. Hall, West Lynn, Mass.; E. H. Martindale, Cleveland, O.; William A. Del Mar, New York City; Wilfred Sykes, Pittsburgh, Pa.

Treasurer, George A. Hamilton, Elizabeth, N. J.

Competition Between Utilities Where Service Demands Require.—The Board of Public Utilities Commissioners, New Jersey, in ordering the Delaware & Atlanta Telegraph & Telephone Company to furnish service to residents in the outlying districts of Mt. Holly, holds that while competition between public utility corporations is undesirable as a general rule, and in most instances involves an added expense to the public, "the rule should not be so hard and fast as to prevent competition where the needs of service demand it." The territory in question is also served by the Farmers' Telephone Company.

HAPPENINGS IN THE INDUSTRY

War Problems Considered by Missouri Utilities Association—Lecture on Industrial Lighting—Automotive Manufacturers Meet at Hot Springs—Power Club Changes Meeting Place to Washington—Arkansas Utility Operators Convention—Miscellaneous News Notes

MISSOURI CONVENTION DISCUSSES WAR PROBLEMS.

President Hugo Wurdack Outlines Conditions—Other Important Topics Discussed on Convention-Cruise.

Stating that all local differences and ordinary problems sink into significance in the presence of the great national peril, Hugo Wurdack, president of the Missouri Association of Public Utilities, in his presidential address reflected the spirit which permeated the eleventh annual convention-cruise of the Missouri organization, held aboard the steamer *Quincy*, May 17 to 19.

Mr. Wurdack said that many central stations are already struggling for the necessary fuel, labor and supplies, and many more will, in the near future, face these problems.

Continuing, Mr. Wurdack said, "We cannot overlook the fact that our utilities are part, and a very important and vital part of our present industrial system, which is the foundation of our national defense.

"It, therefore, becomes the duty of every utility to safeguard and prepare and so build that in the hour of our need they shall be able, continuously and efficiently, to render the service required under these extraordinary conditions. It is, obviously, also the patriotic duty of every state, city, municipality, community and individual to co-operate and lend their assistance to the maintenance of our utilities and our industry, to enable them to meet the requirements, and overcome the many difficulties presented by the rapidly changing conditions, and to this end our utilities, our legislators, our courts, our commissions, our various city boards, and all the public should stand together to present a solid front against the dangers and assaults that would divide and disintegrate our industries. All petty differences and grievances should be laid aside, and all should work together to meet our common need.

"The greatest problem before the utilities at the present moment is fuel, labor and supplies with which to maintain their operations. Even at the unprecedented increases in the cost, the visible available supply is growing less at an alarming rate, and unless some relief comes soon, many of our plants will be compelled to shut down for lack of fuel and supplies.

"No less than the problem of fuel, labor and supplies is the problem of sufficient funds with which to purchase the necessary articles to keep our plants in operation. While utilities, as a rule, have made little complaint, the ever-increasing cost of fuel, labor and supplies is fast reducing the narrow margin, and has even now, in many cases, crossed the line into the loss account. Added to these already excessive burdens of increased price is the increase of expense in many cases due to taxes, licenses and assessment. These tremendous increases in operating expenses must be met in the near future by increased revenue if our industry is to continue."

There were 160 members and guests, including officials from some of the Missouri cities in attendance at the convention. The boat left St. Louis at 10 a.m. and after lunch the first session was held in the main cabin. After the opening address by President Hugo Wurdack, the paper, "Interurbans as State Developers," was read by E. D. Bell, general superintendent, St. Louis Electric Terminal Railway Company.

The next paper, "Variable Versus Fixed Rates," by John A. Porter, vice-president, The Light & Development Company, was then presented.

What Utilities Can Do to Aid Government.

An open discussion on the subject, "What Public Utilities Can Do to Aid the Government in the Present War and Effect of War on the Public Utilities" was led by Louis H. Egan, assistant general manager, Union Electric Light & Power Company. The discussion was based on the discussion at the recent meeting of the National Electric Light Association.

The boat reached Cape Girardeau at 7:00 p. m., where the convention was entertained by the Commercial Club of that city.

Electrically Operated Shovels.

Friday at 9:30 a. m. delegates were taken in autos to inspect the electrically operated shovels used in digging the drainage ditch, which is 40 miles in length and will drain a district of 500,000 acres of swamp land. The cost of the work averages $10 per acre or $5,000,000. There are three shovels, each equipped with one 250-horsepower and one 150-horsepower motors, three-phase 60 cycles. A 13,200-volt transmission line runs from the plant at Cape Girardeau. It is estimated that the land will be worth more than $100 per acre within 10 years and is now selling for $35 per acre, plus drainage tax of $1 per acre per year for 10 years.

Rates and Public Relations Discussed.

The boat left Cape Girardeau at 3 p. m. Friday when the second session was held. The first paper, "Group Block Rate," was presented by J. E. McLeod, comptroller Laclede Gas Light Company. The second paper, entitled "Relations of the Public to Public Utilities," was presented by Fred Naeter, editor *The Republican*, Cape Girardeau.

The executive session was held Saturday at 9:30 a. m. Reports of various committees were read, showing work done during the past year.

Election of Officers.

Resolutions were presented on death of former president and active worker, A. C. Einstein.

After election of following officers and committee members, convention adjourned:

President, Bruce Cameron, United Railways Company, St. Louis, Mo.

First vice-president, J. H. Van Brunt, St. Joseph Railway, Light, Heat & Power Company.

Second vice-president, J. M. Scott, Kansas City Gas Company.

Third vice-president, L. P. Andrews, City Water Company, Sedalia, Mo.

Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Company, St. Louis.

AUTOMOTIVE MANUFACTURERS HOLD ANNUAL MEETING.

Standardization of Starting and Lighting Equipment and Co-operation With Government Discussed.

The first annual meeting of the Automotive Electric Association was held at the Homestead Hotel, Hot Springs, Va., May 17, 18 and 19. The attendance comprised representatives from the following companies: Dayton Engineering Laboratories Company, Dayton, O.; Dyneto Electric Corporation, Syracuse, N. Y.; Electric Auto Lite Company, Toledo, O.; The Leece-Neville Company, Cleveland, O.; North East Electric Company, Rochester, N. Y.; Remy Electric Company, Anderson, Ind.; The Robbins & Myers Company, Springfield, O.; Splitdorf Electric Company, Newark, N. J.; U. S. Light & Heat Company, Niagara Falls, N. Y.; Wagner Electric & Manufacturing Company, St. Louis, Mo.; Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

The objects of this association are to discuss subjects of interest and value to the industry in which its members are engaged, to advance and improve the industry by standardizing equipment and to standardize its application in co-operation with the Society of Automobile Engineers and the automobile manufacturers.

The chairman of the Standardization Committee made his report, appointing various subcommittees to handle various subjects of importance in the industry.

In view of the immediate prospect of the member companies being called upon to supply electrical equipment to the government for use on trucks and aeroplanes, an especially strong subcommittee has bene appointed to consider questions pertaining to this work and to make such recommendations as may be considered advisable from the standpoint of giving the government the best and most prompt service possible.

Efforts were made at this meeting to arrange some manner in which the patent situation pertaining to the industry could be amicably adjusted to the best interests of its members and their customers. The Legal and Patent Committee submitted the following report:

The subject of patents and patent litigation is important, both to the members of this association and also to their customers.

The electric starting, lighting and ignition system of today is a highly ingenious piece of apparatus. Large sums of money and much high-grade inventive and engineering work have been used in developing it. This has been done in a short space of time.

Six years ago saw the first real commercial adoption of the electrical starter. Since then the advance has been very rapid in electrical development.

Much of this development and change has been made necessary by the rapidly increasing requirements and demands of the automobile companies, to keep pace with the rapid improvements in motive power.

Pressure for improvement has made great activity in these electrical inventions; but, since some of the results aimed at are of common interest and knowledge, conflict of patents, and numerous infringement contentions seem bound to occur. And they have occurred.

Some litigation has already been completed, other suits are pending awaiting trial, others are threatened, others are in process of consideration.

A preliminary investigation shows prospect of serious and extensive litigation involving many companies.

This would involve great expense and detract from normal business duties. It particularly leads to great confusion and annoyance amongst the automobile companies and their users in trying to decide the merits of conflicting plans.

The members attending the convention participated in varied forms of recreation, including golf, horseback riding, and target practice. The association holds four regular meetings each year, at 90-day intervals, and the next meeting is scheduled for August.

ELECTRIC POWER CLUB TO HOLD CONVENTION IN WASHINGTON.

Location of Meeting Place Changed to Permit Government Officials to Address Body.

The annual meeting of the Electric Power Club will be held at the New Willard Hotel, Washington, D. C., on June 11 and 12. The change was made to enable the Club to get certain speakers who could not take time to go away from Washington. The program will be short and snappy.

The first day, beginning at 10:00 a. m., will be filled with regular routine business consisting of reports of officers, committee reports, including standardization work, voting on new members of the Board of Governors, voting on amendments, etc.

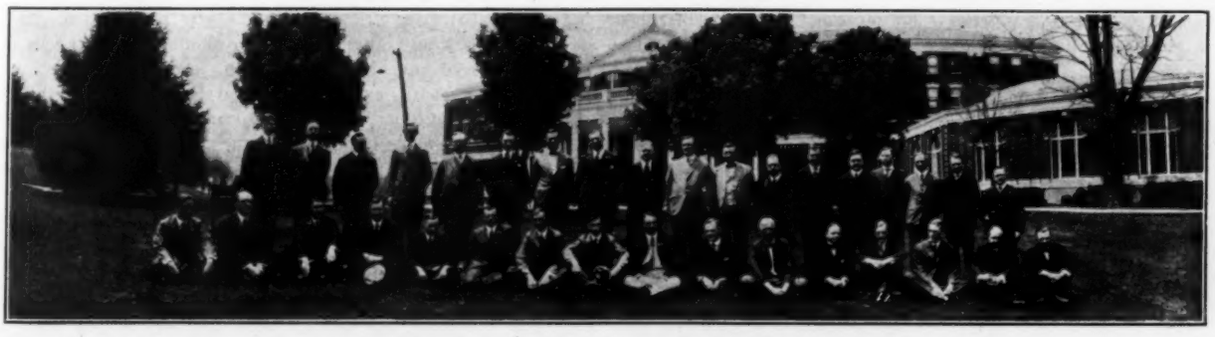
The second day will be filled to overflowing with more general topics or special interest to the executive members.

Howard Coffin will give an address on general manufacturing problems in connections with the present national emergency.

Mr. Patterson will give his paper on Uniform Cost Accounting to be followed by general discussion and perhaps a short talk by a representative of the Federal Trade Commission.

There will be a paper by a member of the Club, analyzing manufacturing conditions during the past two years and showing the cause of increased costs. There may also be some matters that the Army and Navy Department may wish to present.

C. H. Roth, Chicago, Ill., is secretary of the Club.



Group at Convention of Automotive Manufacturers.

NEW OBSERVATIONS ON FACTORY LIGHTING.

Lecture and Demonstration by Ward Harrison Before Illuminating Engineers in Chicago.

An illustrated lecture and demonstration dealing with some new considerations on factory lighting and showing a new type of industrial lighting unit was given before the Chicago Section of the Illuminating Engineering Society on May 18. The lecturer was Ward Harrison, illuminating engineer of the National Lamp Works of General Electric Company, Cleveland, O. Mr. Harrison said that the first aim in industrial lighting was to produce light, later consideration was given to efficiency in lighting, more recently due to the high brilliancy of modern lamps considerable attention was directed to eliminating glare, and the time is now ripe for still more refinement in lighting even to the extent of simulating daylight effect.

By means of a large demonstration apparatus he showed an actual, full-size comparison of about half a dozen typical factory lighting units employing Mazda lamps. First, these were compared as to glare direct from the light source, which of course was most intense with the bare gas-filled lamp even when equipped with a dome reflector unless the observer was at a considerable distance from the unit. Frosting the lamp reduced this glare, using a bowel-shaped reflector limited it to a smaller zone, while use of an opal diffusing disk below the lamp diminished it still more; the greatest reduction, however, was obtained by use of a new unit with mirrored cap covering the lower part of the lamp. The same units were compared as to their production of specular reflection from polished surfaces, like machine parts, etc.; this again showed the best results from the new unit; the test also showed that the bowl-reflector unit with bare lamp gave more objectionable reflection than did the dome reflector with bare lamp. Models of lathe heads and similar working parts of machines were then exposed under the same units to compare the latter as to shadow production. The new unit again showed the least objectionable shadows. The effect of direction of light was shown by illuminating a bust from various directions; this demonstrated that a certain amount of definitely directed light is desirable. A moderate amount of specular reflection is likewise desirable to help discernment in nearly all industrial occupations, because the contrasts of the different surfaces worked upon are very much less than in the case of printing, writing or drawing on paper in offices, drafting rooms and the like.

Mr. Harrison also showed slides of comparisons of the typical industrial units as to light distribution and other characteristics. Tests by Dr. Nutting have shown that there is a fairly definite relation between the general brightness of the field of vision and the limits of contrast that are comfortable; increasing the former 10 times makes it possible to double the limit of contrast. This shows that the more brightly lighted a factory is the less objection will be found from considerable brightness contrasts. There is little danger of overlighting any premises, if attention is given to minimizing glare.

While most industrial occupations do not require entire elimination of glare, there is a considerable number where the conditions are such as to make it highly desirable. For this purpose a new unit has been developed that gives practically pure indirect lighting but does not require the entire ceiling to be of light color. It has a large metal reflector of modified dome shape with white enameled inner surface. A bare Mazda C lamp is used but its tip and almost half its bulb is covered with a detachable close-fitting cap with silvered interior surface, making a mirrored reflector of highest efficiency. The cap can be removed from the lamp when the latter is burned out and applied to a new bulb. There is little opportunity for dust to enter. This cap cuts off all direct view of the filament and reflects the rays upward to the large reflector at the top.

An investigation of factory-lighting conditions in Cleveland was reported. This showed that a mean illumination of 10 foot-candles on the actual working plane could easily be obtained with a consumption of only 1.5 watts per square foot. This gave very comfortable working conditions. In conclusion, Mr. Harrison stated that the urgent need for intensive manufacturing just now practically compelled running shops with two or three shifts a day. This, of course, necessitated the best possible lighting. Such lighting will remove much of the objection of employees to night work, since daylight conditions can readily be produced at comparatively low cost.

In the discussion that followed Mr. Harrison's lecture, he was called on to give further details of the new unit and to explain other features of his investigations. J. R. Cravath, in commenting on the new unit, said he was very glad to see this development in the direction of indirect lighting in factories. However, it should not be forgotten that the ideal should be general lightning with pure indirect or semi-direct units and the brightening up of walls and ceilings should be insisted on.

NEW YORK COMMISSION CO-OPERATING WITH UTILITIES.

Steps Being Taken to Insure Continuous Operation of All Public Service Companies During Hostilities.

The Public Service Commission for the First District, New York, N. Y., is co-operating with all of the great public service corporations of New York City, some 40 in number, and in addition with the New York Telephone Company which is not under its jurisdiction, to the end that there shall be no cessation of functioning on the part of these great corporations during the course of hostilities. The transportation, gas, electric and telephone companies of New York City furnish approximately 20 per cent of the whole quantity of such service furnished in the entire country. It is hoped that when the draft law goes into effect it may be possible for the employees of the several utilities corporations to be so classified and their work adjusted that those within the ages specified by the law may be spared for military service as far as may be consistent with keeping these utilities going. It is also hoped to aid the Government by certifying to it such men as are specialists in their respective lines, who may be needed for important and specific work by the Government. As a result of a circular to the heads of the several corporations, setting forth the urgency of the situation, an informal conference was held at the offices of the Public Service Commission last week at which an organization was formed for the purpose mentioned above. The gathering was addressed by Chairman Oscar S. Straus, Commissioner Travis H. Whitney, George B. Cortelyou, president of the Consolidated Gas Company, and several others. Chairman Straus in his address to the gathering said that if at any time during the war, owing to the lack of men or if for any other cause, there should be a paralysis in the operation of any of the great public utilities of New York City the effect will be felt far beyond New York City. He pointed out that one highly trained man could perform at home functions more important to the National welfare than the work of a regiment in the field. The following executive committee was named to carry out the project contemplated by the conference: J. W. Lieb, vice-president of the New York Edison Company; Walter R. Addicks, vice-president of the Consolidated Gas Company; E. A. Maher, Sr., president of the Third Avenue Railway Company; J. J. Dempsey, superintendent of transportation, Brooklyn Rapid Transit Company; F. H. Thurber, New York Telephone Company; J. H. Jourdan, engineer, Brooklyn Union Gas Company; and Wilbur Fick, president of the Hudson & Manhattan Railroad

ARKANSAS UTILITY OPERATORS HOLD MOST SUCCESSFUL CONVENTION.

Tenth Annual Convention of the Association Held at Pine Bluff, May 16-18.

What is considered to be the most successful convention held by the Arkansas Association of Public Utility Operators, from the viewpoint of both attendance and interest, was held at the Hotel Pines, Pine Bluff, Ark., May 16-18. The attendance far surpassed all past conventions in the number of companies represented, there being representatives from 35 public utility companies in the state.

The first session was held on Wednesday, May 16. Mayor Simon Bloom, of Pine Bluff, delivered an address of welcome, response to which was made by A. Patterson, Texarkana, first vice-president of the association. This was followed by President W. J. O'Brien's annual address, after which P. T. Philips, of Little Rock, spoke on "Commercial Efficiency."

The Thursday morning session was opened with an address by C. A. Meier, St. Louis, on "The Electric Range and Its Advantages for Increasing the Central-Station Load." The afternoon program included a talk by E. W. Smith of St. Louis, on "The Application of Electric Drive to Arkansas" Chief Industries," this being illustrated with slides of lumber mills, foundries and other concerns using electric power.

"The Increase of Taxes on Corporations" was the title of a paper delivered by S. E. Dillon, of Hot Springs, at the Friday morning's session, and this was followed by papers on the "Relations of the Jobber to the Central Station," by L. S. Hunt, St. Louis; "Alternating Current Motors," by L. B. Roseborough, and "Lightning Arrestors as Applied to 2300-Volt Distribution Systems," by J. L. Longino, Arkadelphia.

At the executive session the report of the nominating committee was accepted and the following officers were elected for the ensuing year: President, S. E. Dillon, Citizens Electric Company, Hot Springs; first vice-president, E. T. Reynolds, Arkansas Light & Power Company, Paragould; second vice-president, P. T. Philips, Little Rock Railway & Light Company, Little Rock, and secretary-treasurer, R. B. Fowles, The Pine Bluff Company, Pine Bluff.

At the session of the class B members the following officers were elected: President, J. J. Borney, Westinghouse Electric & Manufacturing Company, St. Louis, Mo.; vice-president, J. B. Trescott, Wesco Supply Company, St. Louis, and secretary-treasurer, George M. Ellis, General Electric Company, St. Louis.

THE BRIGHTNESS OF TUNGSTEN FILAMENTS.

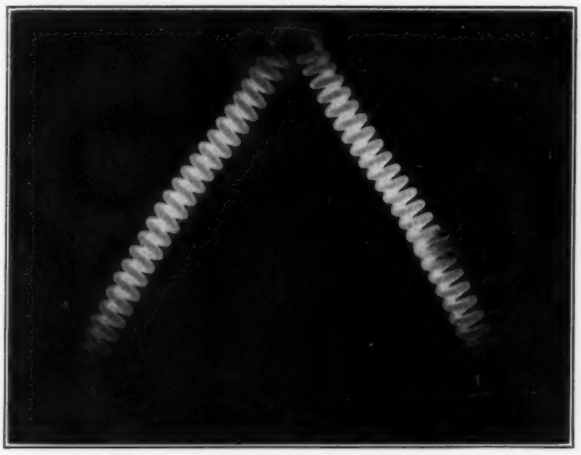
Multiple Reflections of Light From Adjacent Turns of Wire Produce Increased Brightness of Interior of Filament.

The appearance of the spiral filament of an incandescent tungsten lamp presents an interesting problem in radiation. As shown in the accompanying photograph, the inside of the turn in the helix is much brighter than the outside. Measurements of the brightness of the two made with a photometer, using a gas-filled lamp, showed that the interior of the wire was 1.87 times as bright as the outside of the wire. Opinions, however, differ as to the cause of this difference in brightness but experiments carried out at the Bureau of Standards by W. W. Coblentz, which will be published as Scientific Paper No. 300, show that the increased brightness of the interior is produced by the multiple reflection of light from adjacent turns of wire.

It was at one time believed that the difference in brightness might be due to a difference in temperature, but the work of Worthing upon the heat conductivity of tungsten and the work of Langmuir show that this is not a possible explanation. The latter found that the temperature difference could not be greater than five degrees, centigrade, whereas a difference of about 200 degrees would be necessary in order to account for the observed difference in brightness.

The reflecting power of tungsten is lower in the blue end of the spectrum than in the red, hence the intensity of light emitted by one turn of the helix and reflected from another turn is more depleted in the blue than in the red. Multiple interior reflections would thus cause the color of the light from the interior to be redder than that from the exterior. The latter would be relatively more intense in the blue. The difference in this respect is so small, however, that special care would be required to observe the effect.

If the increased brightness observed in the interior is due to the radiation being closer to that of a black body, the effect would be observable by plotting a curve showing the relative energy in the different parts of the spectrum for the radiation from the interior and exterior of the helix. This method would also indicate whether the differences were due to a difference in temperature. Dr Coblentz has consequently plotted



Radiation from Helical Filament.

the energy curves for the spiral filament and also for a straight filament similarly mounted in a gas-filled bulb.

These observations furnish evidence that the effect observed is a result of multiple reflections from the interior surfaces of the helix. For this purpose both filaments were operated so that the outside surfaces had the same intrinsic brilliancy.

After reducing the energy curves to a common maximum ordinate in the visible spectrum, it was found that the area of the energy curve for the inside of the spiral filament was about 36 per cent larger than that of the energy curve for the outer surface. The data for these curves were obtained by using a mirror spectrometer, fluorite prism, and bismuth-silver thermopile. An image of the filament was projected upon the spectrometer slit so that an examination for a particular portion of the surface of the filament could be made. The curves so obtained show that the light emitted from the outside surface is stronger in the blue end of the spectrum than the light from the inside. This indicates that the increased brightness of the light from within is caused by reflections which cut down the blue as compared with the red light.

Tests were also made with a Nicol prism which showed that the light from some parts of the inside of the helix is highly polarized. This indicates that the light from these parts is quite different in quality from the light which would be given off by a black body.

The filament in a gas-filled lamp is wound helically in order to reduce the loss of energy by conduction and by convection. Ordinarily the efficiency of a source of light is in-

creased by decreasing the infra-red radiation. In this case a helical filament has its luminous efficiency reduced by making the radiation from the interior more nearly the same as that from a black body, but the advantage gained by cutting down the losses of energy by conduction and convection more than counterbalances this effect, so that there is a net gain in efficiency.

NEWS NOTES

License Fees for Electric Lines.—The Pennsylvania Legislature is considering a bill, introduced by Senator McKee, Allegheny, authorizing counties to impose license fees for all poles, wires, conduits and cables maintained on public roads or highways in the state.

Uniform Annual Utility Reports in Pennsylvania.—The Public Service Commission of Pennsylvania has called a meeting of representatives of all power companies operating in the state on June 6, to devise plans for the adoption of a suitable uniform annual report to be utilized by the utilities.

Protect Industrial Plant with Charged Wire Barricade.—To prevent any further explosions which might be due to unfriendly agents, the Federal Dyestuffs & Chemical Company, at Kingsport, Tenn., will erect a wire barricade around the big plant, charging it with 2,200 volts. A recent explosion caused damage to the extent of $20,000.

Severe Weather Affects Michigan Company's Operating Conditions.—Owing to the severe weather which has been experienced in Michigan during the past winter, the Commonwealth Power, Railway & Light Company was unable to utilize its water-power facilities to the usual degree and was forced to substitute a larger proportion of steam power at high cost. With the return of spring, the company is able to depend more upon its water power. New hydroelectric facilities in Michigan, with 46,000 horsepower capacity, will be completed within ten or twelve months and will materially benefit the company when completed.

Legislature Kills Bill for Milwaukee Municipal Plant.—The Wisconsin Senate last week killed the Arnold bill authorizing the city of Milwaukee to establish a heat, light and power plant and furnish service for public and private purposes. The action of the Senate followed a long discussion of the measure, which was on the calendar with an adverse report by the committee on corporations. Effective argument of opponents of the bill was that its passage would mean an abandonment of the established policy of the state in suppressing competition among public utilities and establishing a state regulation. The city of Milwaukee has purchased a site and issued bonds for the construction of the proposed lighting plant, but could not furnish service to private parties without a special act of the Legislature.

Winnipeg River's Power Greater Than Niagara's.—That there is as much power available from the Winnipeg River as is now being developed at Niagara is stated in a report of the Dominion Water Power Branch of the Canadian Government. It says that after fully providing for the interests of the Winnipeg Electric Railway Company and the municipal plant of the city of Winnipeg in the Winnipeg River, the remainder of the river drop is divisible into seven power developing centers with possible output of 175,000 continuous 24-hour horsepower, available at 75-per-cent efficiency under present unregulated minimum flow, and 313,000 continuous 24-hour horsepower available for the proposed 20,000 second feet dependable minimum flow under regulated conditions. Total resources of the nine sites or centers are 249,000 and 418,000 continuous 24-hour horsepower under the above respective conditions of flow.

Seattle Company Takes Military Census.—Officers of the Puget Sound Traction, Light & Power Company have started taking a war census of its 3800 officers and employees. The company was first of the northwestern employing corporations to anticipate the federal government's conscription of men for the army and desires to know at once the number of its men liable for draft, the number qualified for promotion in their present lines of service and those who have special training in other lines who could be called to new work by the Stone & Webster interests.

New York National Guard Recruits Sought from Electrical Industry.—At the suggestion of Governor Whitman of New York, a conference, presided over by Col. Charles Sherrill, leader of the preparedness parade in New York City last May, and attended by the trade marshals, it was decided to apportion a certain shortage in war strength of the National Guard among the various trades of the state. Under instructions from this committee and as representative of the electrical industry, C. P. Lashelle, vice-president of W. R. Ostrander & Company, has sent a circular letter to every manufacturer, jobber, central station and telephone company in the state asking them to bring the shortage to the attention of their employees and help in the securing of recruits to the New York National Guard.

Enlistment of Electrical Men in Kansas City.—Recruiting officers in Kansas City, Mo., are suggesting to industrial corporations that employees who wish to enlist, investigate the various branches of the service, that they may get someplace where their technical experience will be of value. The regular army lieutenant in charge of one station, who in the army is in the artillery service, finds especial difficulty getting recruits for this attractive branch, where technical men, and mechanics of any kind, would find work to their liking which they can do well. It is said that the enlistments from the electrical industry have been fairly satisfactory; the signal corps is in good shape. Many men of some electrical experience have, however, enlisted in the infantry.

Chicago, Milwaukee & St. Paul Railway to Extend Electrification of Its Lines.—To meet the increasing cost of fuel oil the Chicago, Milwaukee & St. Paul Railway Company has begun to electrify the Puget Sound division of its transcontinental line. This part of the system traverses the great virgin forests of Washington, and oil has been used to avoid danger of forest fire from sparks. Electrification of the stretch from Othello to Cle Elum had been started, but the crews have now been shifted to Cle Elum, to work from there to the Puget Sound terminals. As previously stated the cost of preparing the line between Othello and Seattle for the operation of electric locomotives will be about $6,000,000, including material, wages and the construction of six substations. It is estimated that electric locomotives will be in use on this line by October 1, 1918.

Franklin Medals Awarded.—The Franklin Medal, which is awarded annually by the Franklin Institute, Philadelphia, Pa., to "those workers in physical science or technology, without regard to country, whose efforts, in the opinion of the Institute, have done most to advance a knowledge of physical science or its applications," were awarded May 16 to Hendrik Antoon Lorentz, president of Royal Academy of Sciences, Amsterdam, and professor of mathematical physics, University of Leiden, in recognition of his "researches which have so largely contributed to laying on a new foundation our knowledge of the nature of light and in developing our ideas concerning the ultimate constitution of matter"; also to David Watson Taylor, chief constructor and chief of Bureau of Construction and Repair, United States Navy, in recognition of his "fundamental contributions to the theory of ship resistance and screw propulsion, and of his signal success in the application of current theory to the practical design of varied types of war vessels in the United States Navy."

Notes on Commercial Practice

New-Business Methods, Policies, Rates and Kindred Central Station Matters for the Man Engaged in Selling Electricity

Byllesby Companies Arrange for Additional Hydroelectric Power to Conserve Coal Supply.

Arrangements for the purchase of additional hydroelectric power by several Byllesby utility companies have directed attention to the fact that the majority of the central stations of this organization either are operated by water power or use natural gas fuel obtained under long-term contracts. It is conservatively estimated that not less than 2,500 carloads of coal will be saved during the remainder of 1917 alone under the contract for the purchase of hydroelectric energy by the Northern States Power Company from the Wisconsin-Minnesota Light & Power Company, or an average of 10 cars per day for the balance of the year. An existing contract between the two companies has been amended so as to give the Northern States Power Company much more power from the new development near Chippewa Falls than was originally contemplated during the next five years. The additional water power in 1917 will amount to about 40,000,000 kilowatt-hours. Continuation of the company's rapidly increasing business has furnished a ready market for the power.

The San Diego Consolidated Gas & Electric Company, which is a prominent subsidiary of Standard Gas & Electric Company, has received authority from the California Railroad Commission to contract with the Southern California Edison Company for a supply of hydroelectric power to supply the total demands on its distributing system and a 100-per-cent increase in future business. The contract will be for a period of 20 years and will enable the San Diego Company to practically close down its 16,000-horsepower steam plant, which uses oil for fuel, and hold the steam plant as a reserve. The Southern California Edison Company will build a duplicate transmission line from Santa Ana south to connect with the transmission system of the San Diego Company at San Juan Capistrano. Delivery of the water power will start early in 1918.

The Eureka division of the Western States Gas & Electric Company, also a subsidiary of the Standard Gas & Electric Company, has made a contract with the Northern California Power Company for hydroelectric energy to be employed at Eureka and vicinity and in gold-dredging operations. The Eureka company has a water power of its own on Trinity River, but increasing business has necessitated the generation of considerable power by steam with oil as fuel. The additional water power, which will be available in September, will permit the discontinuance of steam operation.

Electric Truck Saves $800 a Year on Horse Equipment.

The New York Electric Vehicle Association has compiled some interesting facts and figures relating to the cost of operating and maintaining a small horse-drawn delivery outfit, consisting of three horses and two small trucks or wagons. The purpose of presenting these data is to show the comparative cost of this type of delivery system and the cost of maintaining and operating an electric vehicle capable of doing the same work. It is believed that most owners of horse and wagon equipment have only the vaguest idea as to actual cost. Very often he thinks that food, stable and veterinary costs and drivers' wages are a complete summary of his expense and people are often inclined to make comparison on this basis of estimate. This is unfair, not only to the horse owner's pocket-book but to the motor vehicle.

The following is an illustration of correct accounting for one year for three horses and two wagons, based on actual conditions in New York City:

Board at $1 per day, $1095; shoeing at $2.25 per month, $81; services of veterinary, $30; clipping, $5.55; repairs and painting of wagons, $200; repairs to harness, $45; amortization for horses at 20 per cent (assuming the value of a horse at $200), $120; amortization for wagons and harness (assuming value at $375), $75; insurance, $25.86; interest on investment, $103.50; total, $1780.91.

An electric vehicle of the type capable of doing the same amount of work as this horse and wagon equipment can be operated and maintained at a cost from $900 to $1000 a year. This figure is based on a compilation of costs exactly the same as for the horse-drawn equipment. In addition to the economy of approximately $800 per year, there are many other advantages in favor of the electric; its life is from twice to three times that of a horse, its average working speed is more than double the speed of a horse, it is cleaner and requires less space. Statistics of the New York Vehicle Association show a gratifying number of merchants and large corporations now using the electric vehicle, but there are 108,036 horses in New York City still to be replaced by the modern system of delivery.

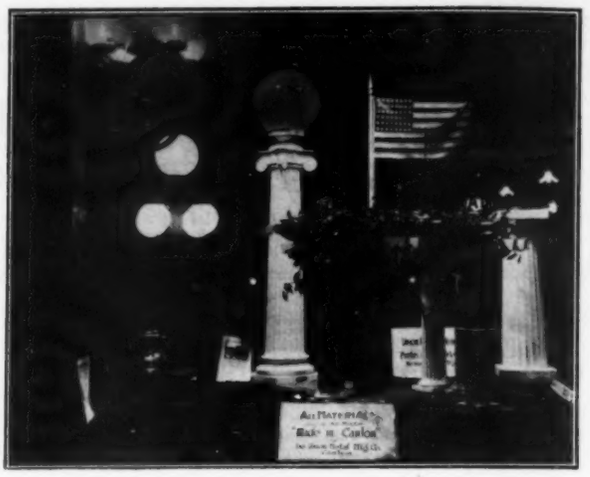
Effective First-Aid Instructions for Electric Station Employees.

In connection with an organized movement for safety first in all departments of operation, the San Joaquin Light & Power Corporation, operating at Fresno, Cal., and vicinity, has devised a series of simple and important directions for first-aid treatment of ordinary injuries and disorders as may occur to power-station employees in the course of their work.

These instructions, brought to the direct notice of all station operators and other attendants, have proved highly effective for the prompt and efficient treatment of minor injuries, and cover such phases of frequent mishaps as abrasions and cuts; non-bleeding injuries; nose bleeding; severe bleeding; eye injuries; fire burns; electric burns; acid burns; alkaline burns; eye burns; splinters or slivers embedded in the skin; fractures; dislocations; dizziness and headache; chills and cramps; internal poisoning; heat prostration; insect bites; electric shock; unconsciousness from fainting; shock following injury, and the like.

Specific rules for the correct and immediate treatment of injuries of this nature have become generally standardized, while the company has supplemented where necessary more extended information for the complete guidance of employees. The accompanying brief examples afford a comprehensive idea of the manner in which these instructions are summarized for employees' benefit:

Electric Burns: Do not open blisters. Use burn ointment (3 per cent bicarbonate of soda in petrolatum) freely on sterile gauze, applied directly to burn. Cover with several thicknesses of flannel or other soft material, then bandage, but not tightly.



Two Typical "Made in Canton" Products Displays in One of the Windows of the Central Power Company, Canton, Ohio.

Severe Bleeding: Place the patient at rest, with injured part elevated. Apply sterile gauze pad large enough to allow pressure upon, above and below the wound; bandage tightly. If severe bleeding continues, secure doctor's services.

Abrasions and Cuts: Drop 3 per cent alcoholic iodine into the wound freely, then apply dry sterile gauze to wound and bandage it. Do not cleanse wound otherwise.

The value of a series of concrete suggestions of this character can hardly be over-estimated. Covering miscellaneous mishaps as are occurring from day to day in electric power stations, they afford a ready basis for intelligent attention in the worker's behalf, with noticeable advantage both for the employe and the company in correcting minor injuries that might result seriously without prompt and proper care.

Central Connecticut Power & Light Company Encourages Gardening by Offering Cash Bonus.

In an announcement made by the Central Connecticut Power & Light Company, East Hampton, Conn., to its employees, the company states "an appeal has been sent out by Governor Marcus H. Holcomb, that every person in the State do all within his ability to offset the present and future serious world-wide food shortage, by raising as large crops as possible this year. Many factory owners have plowed up land and apportioned it out to their employees for garden purposes.

"Our organization is so distributed over an area of 200 square miles that it is not practicable for the company to plow up one large tract for the benefit of all of its employees. The company, therefore, to encourage its employees to have gardens and large gardens, will assist by advancing the money necessary to cover the cost of plowing, fertilizing and seeding. The Company will give to each employee a cash bonus of 10 per cent of the value of the crops at the time of harvest.

"The season has been slow and now is early enough for plowing and planting.

"Gardening this year will not only be more profitable than ever before within our memory, but for those who cannot enlist it will be the most patriotic thing they can do."

Republic Company Takes Emergency Contract.

The Republic Railway & Light Company has arranged to supply the Republic Iron & Steel Company with 2,500 kilowatts of power within four or five days, to take the place of the 2,500-kilowatt turbine of the Republic Iron & Steel Company destroyed by an explosion recently. The extension to the Republic Railway Power & Light Company's power house, which is partly in operation, will provide ample capacity to take the additional load.

Display in Central-Station Window of Locally Made Products Proves Valuable.

The Central Power Company, of Canton, O., has for some months worked out an effective co-operative scheme which has developed good will toward the company on the part of local manufacturers. One of the display windows in this central-station company's office on Cleveland Avenue has been placed at the disposal of the Canton manufacturers, who can make whatever display they wish of "Made in Canton" products for periods of two weeks. The displays do not have to be electrical necessarily, although most of them have had electrical interest. This scheme insures a new window display every two weeks and accommodates as many as 26 manufacturers a year. The exhibits are not strictly confined to customers of the Power Company, but are available to any members of the Canton Chamber of Commerce, with which the co-operative scheme was worked out. This scheme was developed by F. H. Golding, general manager of the Central Power Company, and is proving as successful as a similar scheme he carried out at Rockford, Ill., while manager of the Rockford Electric Company.

In the upper left corner of the window is the slogan of the Canton Chamber of Commerce: "Canton, the City of Diversified Industries." Of the two illustrations herewith, one shows the window fitted out with an assortment of ornamental columns and standards made by the Union Metal Manufacturing Company. Another shows a group of electric-cut coffee mills and meat choppers made by the Electric-Cut Manufacturing Company. The taste and skill shown in these typical displays is indicative of the appreciation of the Canton manufacturers of this free opportunity to display their products.

Atlanta Company Secures Big Addition to Its Power Load.

Very nearly as much business has been added in the past 30 days by the Georgia Railway & Power Company, Atlanta, Ga., as was added during the whole year 1916. W. R. Collier, sales manager, reports eleven new customers listed in this period whose estimated probable consumption will amount to approximately 17,000,000 kilowatt-hours per annum. This total does not take into consideration additional power contracted by customers already on the company's lines. It includes only those who have not been using it heretofore.

The recent increase includes three contracts whose estimated total aggregates 14,800,000 kilowatt-hours per annum, these being the Fulton Bag & Cotton Mills, Atlanta, with 10,000,000 kilowatt-hours per annum, and the Southern Cotton

Oil Company at Fort McPherson, and the Elberton Oil Mills at Elberton with lesser figures.

The Fulton Bag & Cotton Mills' contract is a notable addition. Hydroelectric service there displaces a high class steam-turbine plant. That portion of the mills which has been driven electrically from energy generated by the mills' steam plant will be driven at once by central-station power. The mechanically driven portion of the mill will be electrified later, provision for this being included in the contract.

The Effect of Coal Prices on Central-Station Rates.

During the past year the appalling advances in coal, labor, power-plant and line supplies has become a serious burden to public utilities. They stand alone among all manufacturers apparently immune from the assault of high and extortionate markets, utterly unmoved by the steady encroachment upon its gross earnings.

Speaking before the recent convention of the Missouri Association of Public Utilities in favor of variable central-station rates, J. A. Porter said that the public service company alone continues to sell its products at the same price, or at lower rates than it did a year or two ago when prices were normal.

Endurance, or sufferance, however has its final limit and the continued upward trend of everything entering into the production cost must at an early date force recognition, unless the utility proposes to donate its capital as well as profits to an unappreciative public.

It has been the practice of utilities to sell their products at a "fixed rate" that does not take into consideration the fact that the price of the component elements that enter into the rate column, are in many cases variable.

However important other elements are, coal easily takes first place at this time. Its price is an unknown quantity, the question most vital being the ability to obtain it at all.

The importance of coal as a variable element will be clearly shown by consideration of the following tables which were compiled with a view of showing actual conditions.

The figures were provided by ten utilities in Missouri and adjoining states, four of which were straight electric plants and six operating also gas, water or ice plants.

For obvious reasons the names and location of the utilities cannot be given but the coal conditions obtaining with them are fairly representative of other small plants in cities ranging from 3,000 to 15,000 in population.

PER CENT OF FUEL COSTS TO MANUFACTURING COSTS AND GROSS EARNINGS.

	Percentage coal to manufacturing cost.	Percentage coal to gross earnings.
Plant No. 1	69.0	15.4
Plant No. 2	51.9	17.2
Plant No. 3	67.3	21.2
Plant No. 4	49.7	13.4
Plant No. 5	62.5	13.2
Plant No. 6	60.6	20.3
Plant No. 7	52.1	17.3
Plant No. 8	64.9	29.0
Plant No. 9	56.4	31.8
Plant No. 10	45.7	13.4
Gross receipts		$378,048.00
Manufacturing cost		110,273.00
Coal costs		65,213.00

	Per cent.
Manufacturing costs to gross receipts	29.2
Coal costs to gross receipts	17.2
Coal costs to manufacturing costs	59.1

The variations in percentage of cost as shown by the table may be accounted for in many ways. Such variations are always complex and require special analysis in each case, but among the causes may be cited:

Differences in freight rates; in the character of machinery used, in daily output, etc.

From the data above secured a calculation will show the percent increase in manufacturing costs and the relation to gross earnings as the price of coal advances, it being assumed that all other expenses and revenues remain stationary.

PER CENT INCREASE IN MANUFACTURING COSTS, ETC., AS COAL PRICES ADVANCE, OTHER ELEMENTS STATIONARY.

	Old prices.	10%	20%	30%	40%	50%	100%
Coal to mfg. costs	59.1%	61.4	63.4	64.9	66.9	68.5	74.3
To gross receipts	17.2	18.6	20.0	21.2	22.5	23.8	25.6
Amount increase	None	$6.521	13.042	19.563	26.085	32.606	65.213
Per cent gross to equalize the advance in coal	None	1.72	3.44	5.16	6.90	8.62	17.2

"WIRE YOUR HOME TIME" CAMPAIGN CLOSED MAY 15.

The Society for Electrical Development Reports Event of Great Benefit in Building Business for the Industry in Many Cities.

Tuesday, May 15, marked the close of "Wire Your Home Time" campaign held during the past six weeks throughout the country.

The preliminary reports received by the Society for Electrical Development indicate that in spite of many adverse conditions, such as increased costs of labor, materials and correspondingly increased prices charged for wiring, as well as scarcity of essential equipment, the event was a marked success. Several cities have already stated that they obtained even more business than the record results attained during last year's "Wire Your Home Month."

One of the important features of the campaign has been the remarkable increase in the use by participants in the event of newspaper advertising space.

The Society sent out to its members and to the industry at large complete advertising and sales data, and during the six weeks received orders for several thousand cuts. That these special housewiring advertising helps sent out by the Society and others issued by manufacturers, jobbers, and advertising agencies were widely used, is evidenced by the fact that the Society has already collected copies of advertisements inserted in the newspapers of several hundred cities and towns.

Other features of the event were advertising by manufacturers and jobbers of lamps, sockets and appliances in the national magazines, special window-display cut-outs and suggestions issued by the Society in co-operation with manufacturers and jobbers, and the "Wire Your Home Time" prize contest in which the Society offered 35 cash prizes aggregating $1250 to salesmen of its members certifying to wiring contracts signed by them during the six weeks' campaign.

Entries were received from salesmen of member companies in several hundred cities and towns. The awards will be divided equally among cities in five classes each made up according to population. Competing salesmen were required to certify to the number of signed contracts secured by appearing before a notary, or central-station executive, and making affidavit on blanks furnished by the Society.

The Society's Committee in charge of "Wire Your Home Time" contest, of which G. M. Sanborn of Indianapolis is chairman, will announce the prize winners on or about June 15.

Three Months' Pay Given Employees on Military Duty. —The Boston Edison Company has taken active steps to put itself in line for public duty in connection with the national emergency. Employees are urged to consult the company as to the best means of patriotic service, whether in the company or in active military duty. For at least three months, all employees absent on military or naval duty will be regarded as being on special leave of absence and their rating not affected. Those called for duty receive full pay for 13 weeks, this in addition to two weeks' absence yearly with pay, which has always been allowed by the company for such duty.

Electrical Construction Notes

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

Simple Method of Supporting Conduit from I-Beams.

By A. A. Peggs.

In industrial plants it is very common to find conduit supported directly from the roof trusses or from the ceiling beams or other structural work. Considerable time is frequently wasted by the electrician in running conduit underneath such structural work because, if the time is taken to drill holes in the flanges of these beams for mounting pipe straps, this is a very laborious job.

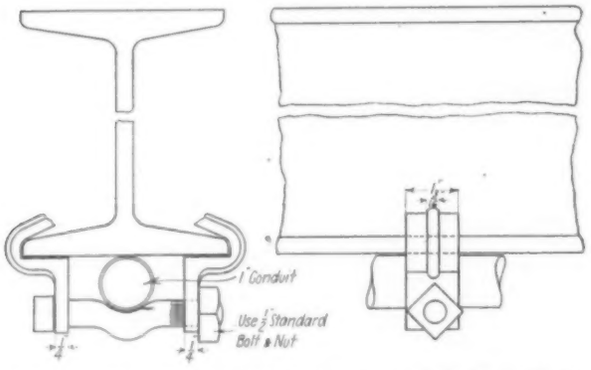


Fig. 1.—Clips for Supporting Conduit Lengthwise Under I-Beams.

For this reason it has been found desirable to use some sort of clip that can be easily fastened around the flanges of I-beams, T-bars and the like. I have devised the type of support shown in the accompanying illustrations, which entirely eliminates the need for drilling the beams and makes it very easy to mount the conduit.

Fig. 1 shows the method of supporting conduit lengthwise under I-beams. A pair of clips is used which are held together by means of a standard bolt and nut of such size as is suitable for the weight of the conduit to be used and the width of the beam flanges. The conduit is placed between the bolt and the base of the beam. By using a straight bolt it is possible to mount either a ½-inch or ¾-inch conduit, or if the bolt is bent as shown it is possible to mount 1, 1¼, or 1½-inch conduit. If a large amount of the larger sizes of conduit is to be run it is better to make the side clips a little longer, as this avoids bending the bolt.

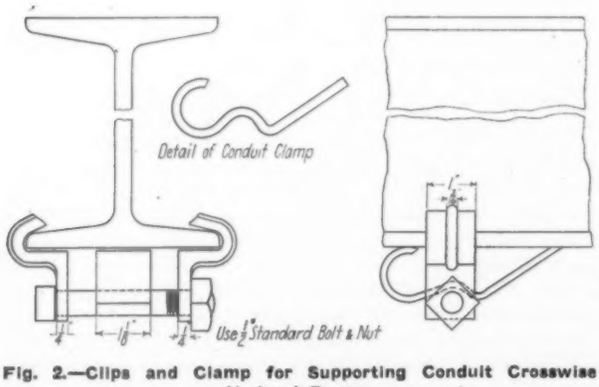


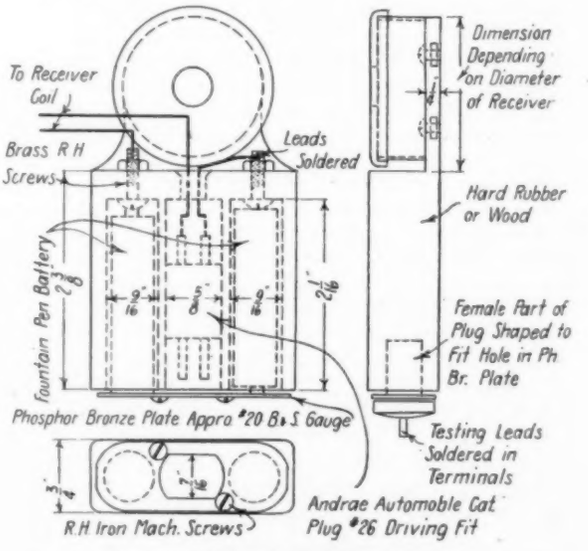
Fig. 2.—Clips and Clamp for Supporting Conduit Crosswise Under I-Beams.

In Fig. 2 is shown how the same side clips can be used for supporting conduit that is run at right angles across the beams. In this case an additional conduit clamp is used. This I have made usually from 3/16 by 1-inch strap iron. In case of inverted T-bars or where two channels are placed side by side the same form of clip can be used.

Compact Testing Outfit for Electricians and Inspectors.

By B. Berssenbrugge.

The electrical man who has to do with the construction, inspection or maintenance of electrical circuits should have available a compact and dependable testing outfit which he can use without delay in order to test out circuits, grounds, etc. In the accompanying diagram is shown such a test set used by the municipal electrical inspectors of Milwaukee, Wis. This outfit is very sensitive and so compact that it can be carried in the vest pocket. In service it has been found to give complete satisfaction.


To Receiver Coil
Brass R H Screws
Leads Soldered
Dimension Depending on Diameter of Receiver
Hard Rubber or Wood
Fountain Pen Battery
Female Part of Plug Shaped to Fit Hole in Ph Br. Plate
Phosphor Bronze Plate Appro #20 B & S Gauge
Testing Leads Soldered in Terminals
R.H. Iron Mach. Screws
Andrae Automoble Cat Plug #26 Driving Fit

Compact Test Set for Inspectors Etc.

The frame is made of hard rubber or wood. The telephone receiver used may be any watchcase receiver with a laminated magnet. The dry cells are of the so-called fountain-pen battery type, and are held in place by a phosphor-bronze plate that is held by two iron round-head machine screws. Renewal of the battery is easily made by simply removing this plate and replacing the cells. The plug connector used is the Andrae automobile catalog No. 26, the female part being shaped to fit the hole in end plate in order to give more body

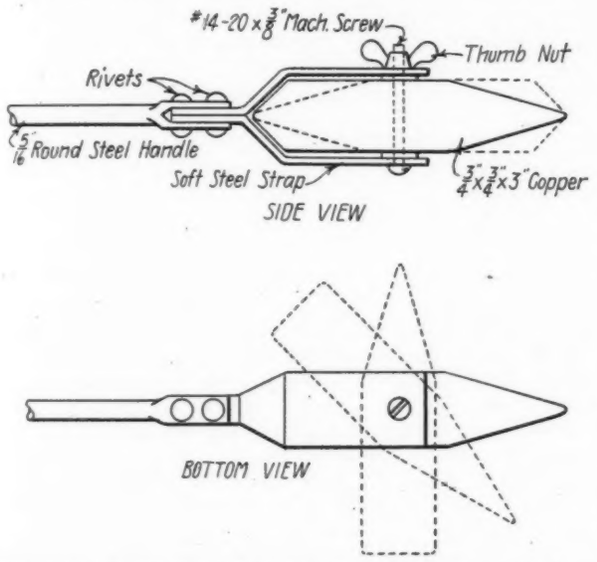
to the plate, and the testing leads are soldered to the same. The male part of the plug is held in place either by means of a pin or by making a driving fit.

Adjustable Two-Point Soldering Iron.

By T. T. Tallman.

I find that in the electrical shop it is frequently very desirable to have handy a soldering iron with two differently shaped points, both of which are heated at the same time. I have made up an iron providing for two such points that are adjustable and instantly ready for use. This iron, as shown in the accompanying sketch, is readily adjusted to any position and is especially convenient for soldering armature leads without removing the armature from the motor casing.

In fact, it is handy for any job where there is only a limited space to work in. This construction is especially adapted to the needs of the armature winder, as it enables him



Adjustable Double-Point Soldering Iron and Some of Its Positions.

to hold the iron on the work with more ease. It also avoids heating the hand while holding the iron in the upright position.

The construction of the device is shown fairly well from the sketch herewith, which shows some of the various positions that the iron can be turned to.

I think that this will convince most any reader that this iron has decided advantages over the ordinary single-point iron with rigid handle that is in such common use.

Simple Test for Short Circuits on Lighting Circuits.—It is a common practice among many electricians when called in to remedy an evident short circuit on house or other lighting circuits to first look for a defective socket, attachment plug, cord or portable lamp, fix it and then put in new fuses on both sides of the circuit. It happens frequently, however, that the actual source of trouble was not located or not properly rectified. This immediately will cause both fuses to blow again. After numerous such cases it occurred to me to put only one fuse in after apparently fixing the trouble and to put a lamp in the fuse receptacle on the other side of the circuit. If there is still a "short" on the line this lamp will burn brightly; if the trouble has been corrected the lamp will not burn at all and it is then time to put in the other fuse. Should other lamps be turned on when making this test, the test lamp will burn dimly. This simple scheme has saved many fuses.

Richard T. Braun.

Among the Contractors.

R. E. Hanlon, Syracuse, N. Y., has submitted a low bid at $4894 for electrical work in the new school to be erected on Jefferson Street in Syracuse.

Carr & Schultz, Trenton, N. J., have received the contract for electrical work in the new county garage and storage plant to be erected on Brunswick Avenue, Trenton.

The firm of Austin & Kanter has been dissolved and H. B. Kanter has organized the H. B. K. Electric Company, 92 Jackson Avenue, Long Island City, N. Y., which will do electrical contracting, engineering and maintenance. Mr. Kanter invites manufacturers and jobbers to send him catalogs.

Elmer D. Wilson, 179 Clinton Avenue, Newark, N. J., has received a contract for electrical work in a new business building to be erected on Hollywood Avenue, East Orange, by Max Gray.

The electrical supply business of C. A. Fischer, 604 Spring Street, West Hoboken, N. J., has been acquired by Emil Schneider & Son, operating a house-furnishing store on Bergenline Avenue, Union Hill. The electrical business will be continued and special attention given to this feature. Mr. Fischer has become manager of the new department.

Walter J. Coleman, 29 Willow Street, Jersey City, N. J., submitted the low bid for electrical work in the new school to be erected by the Board of Education on Eighth Street, at a cost of $3373.

Walker Electric & Plumbing Company, plumbing, heating and electrical contractors, announce the opening of headquarters at 620 Rhodes Building, Atlanta, Ga., with estimating and construction departments prepared to furnish the same accurate and efficient service that now characterizes its Rome and Columbus branches.

Paul H. Jaehnig, Incorporated, 109 Bank Street, Newark, N. J., has been awarded a contract for electrical work in the new boiler plant to be erected by the county at Overbrook Hospital. Piper Brothers, 112 South Tenth Street, have received the contract for the steam installation at a cost of $71,500.

The Kingsbury-Samuels Electric Company, 213 North Calvert Street, Baltimore, Md., has received a contract for electrical work in a new apartment house to be erected on Fortieth Street.

J. J. Augutter & Company, electrical contractors, Seattle, are making good progress with the electrical work on the Frederick & Nelson store building in that city. This is a reinforced concrete structure, 300 by 300 feet, five stories, basement and sub-basement, being erected under contract by James Black Masonry & Construction Company, St. Louis. Augutter & Company's contract consists of wiring the building and the installation of all electric lighting equipment.

NePage-McKenny Company, electrical engineers and contractors, Seattle, Wash., and Portland, Ore., reports electrical activities of the company as follows: Installation of panel board work for boats being built by Skinner-Eddy Corporation, Seattle; electrical wiring for 16 boats being built by Willamette Iron & Steel Works, Portland, Ore.; similar work on twelve 290-foot, 4-mast schooners for Standifer-Clarkson Company, Portland; all electrical work on Pantage's Theater, Tacoma; and recently completed similar work on Rialto Theater, Butte, Mont., for Jenson & Von Herberg, Seattle. This company has the contracts for complete electrical work on postoffice buildings being erected at Wenatchee and Vancouver, Wash., and at Portland, Ore.

USEFUL WIRING HINTS

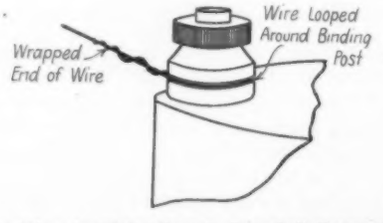
A collection of some short-cut or otherwise valuable suggestions which, though not entirely new, are not as well known by wiremen as they deserve to be. Most of these suggestions have been submitted for publication as "Dollar Wiring Kinks," which department is intended for new and original ideas only and will reappear soon.

Telephone as a Check on Motor Operation.—In a school building there is an exhaust ventilating fan installed in the attic space between the third floor and roof. The direct-current motor driving this fan used to give considerable trouble from sparking brushes. By using a better grade of brushes and adjusting them carefully this trouble was greatly reduced. To provide a ready check on the operation of the motor, I installed a telephone transmitter near its commutator and connected with a battery, coil, switchhook and telephone receiver in the engine room in the basement. By lifting the receiver from its hook I can instantly tell whether the commutator is running right by noticing the hum. If there is sparking or sputtering or scratching a distinctive sound is heard and I can take care of it promptly. James Burns.

Hacksaw-Blade as Emergency Brush-Holder Spring.—A short time ago I had a peculiar motor repair job. I found that the motor trouble was due to a weak brush-holder spring which caused sparking of a carbon brush. No amount of adjusting of the old spring would give the proper tension. As an emergency repair, pending the arrival of a new spring, I used a piece of an old hacksaw blade which gave a satisfactory tension for the time required to secure the new spring. M. J. Moriarty.

Marking Circuit Terminals.—On many occasions when disconnecting electrical apparatus, especially motor leads, end cells of storage batteries, copper bases, polarized wires, etc., it is desirable to mark the individual connections so to facilitate reconnecting, or for some other reason. There are many ways of marking, by use of a tag, band of tape or string, etc. I have found that the most reliable method is to mark the metal lug or stud or connector with corresponding marks by use of a center or prick punch and a quarter-inch iron chisel. Use, say, one chisel mark and three punches or three chisel marks and two punches or make letters or designs with the chisel, such as TX, IM, NA, etc.; there is an almost endless variety of simple combinations possible. Also, if the record of the markings is put on the time card or work sheet, the same man does not necessarily have to reconnect or follow up the work in case of moving. Robert Oster.

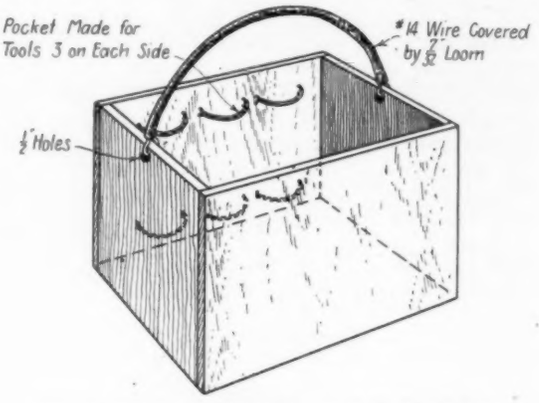
Reliable Connection of Automobile Dry Cells.—When connecting dry cells for use in automobile ignition I find that much trouble is caused from broken connections due to the wires slipping from the binding posts because they were not twisted around. By first looping and then twisting the wires



Proper Way to Make Secure Dry-Cell Connections.

as shown there is much less danger of an open circuit than with the plain partial loop. If vibration causes the binding nut to loosen, the twisted end keeps the wire from sliding from under the nut. M. J. Moriarty.

Handy Box for Carrying Wiring Supplies and Tools.—To make a handy box for carrying knobs, tubes, wire, switches, tools, etc., take a common soap box (preferably about 10 by 10 by 12 inches) and bore a hole on opposite ends large enough to slip a piece of No. 14 wire through. Slip a piece of one-fourth-inch loom over this wire and fasten the ends as



Handy Case for Carrying Material to Small Job.

a handle or bail. You can convert this case into a compact and handy tool chest as well by taking small pieces of loom or wire and tacking on the inside of the case with saddle staples. Make the loom or wire in the shape of an arch, thus forming a pocket to slip in hammers, drills, screw drivers, pliers or any other tools needed for the job and still leaving plenty of room for your wiring material. R. A. Jeffers.

Fishing Wires into Constricted Partition.—A difficult job of fishing was experienced by me a short time ago while trying to fish coils into a partition that had a number of obstructions in it, making a very constricted opening. After wasting considerable time and much patience on fishing with an ordinary snake both from top and bottom, I hit on another scheme. It was simply to feed into the opening from above about 20 yards of ordinary bell wire that I had along, this forming a number of irregular loops. On going to the bottom opening I then pushed up the hooked end of the snake from below and caught one of the loops of bell wire. In this way I pulled down the entire amount of bell wire, which served to permit pulling in the circuit wires. Howard St. Clair.

Easy Wiring of Fixture Arms.—It is frequently very difficult to draw the wire into fixture arms because of sharp or numerous bends combined with the restricted wiring space available. I have found that it is comparatively easy to overcome this difficulty by use of a beaded chain from a pull-chain socket or receptacle. By means of a loop knot tie a strong fish cord to the end of the chain. Now slip the chain into the fixture arm and shake or tip the latter back and forth until the chain slips through the more or less tortuous passage. The weight and ball-bearing character of the chain enables it to slip around even right-angle bends with little difficulty. This may be an old trick, but I have been surprised at the waste of time, labor and strong language on the part of young fellows who did not know of it. Thomas Young.

Bench Support for Use in Wiring Fixtures.—In assembling and especially in wiring fixtures it is desirable to have some means of supporting them conveniently. This is especially true of large electroliers with many arms that are awkward to handle and liable to be bruised if not properly supported. I have found a good scheme for supporting such fixtures to be the following: Take a crowfoot and secure it to the bench by means of screws. Screw into the crowfoot a nipple from four to eight inches long, depending on the shape of the fixture. Now screw the body of the fixture to the top of the nipple, which affords a strong temporary support for the purpose. John O'Neil.

National Association of Electrical Inspectors

HUBERT S. WYNKOOP, President, 1574 Fiftieth Street, Brooklyn, N. Y.
WASHINGTON DEVEREUX, Vice-President, 131 South Fourth Street, Philadelphia, Pa.
WILLIAM LINCOLN SMITH, Secretary and Treasurer, Concord, Mass.

R. P. STRONG, Representative on Electrical Committee of National Fire Protection Association, 809 Hibernian Bank Building, New Orleans, La.

Executive Committee
J. C. FORSYTH, Chairman, 123 William Street, New York City.

SECTION REPRESENTATIVES:
C. H. Fletcher, J. C. Digby, British Columbia.
A. W. Hopkins, L. N. Heebner, Western New England.
Washington Devereux, A. H. Lilley, Philadelphia.
E. N. Davis, H. A. Knight, Eastern Massachusetts.
M. L. Pomares, J. C. Forsyth, New York City.
B. C. Hill, G. A. Cleary, California.

MEMBERS AT LARGE:
k. W. Adkins, St. Louis, Mo.
Emil Anderson, Minneapolis, Minn.
F. G. Hartwell, Boston, Mass.
J. E. Latta, Chicago, Ill.
James B. McCarthy, Detroit, Mich.
H. G. Veit, Cleveland, O.

"LET THE CODE DECIDE."

SECRETARY'S MESSAGE.

The Secretary wishes to state that the delay in announcing any new committees, etc., as was expected to be done some time ago has been due to the fact that President Devereux has been ill for several weeks with articular rheumatism and is still unable to do very much. He writes me that he is to take a convalescing vacation for two or three weeks and then expects to be emphatically on the job. We all join in wishing him a speedy return to the best of health.

The Secretary has received the following communications in connection with the matter of removing enamel from conduit fittings the discussion of which matter was begun in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of April 21.

COMMENTS ON REMOVAL OF ENAMEL FROM CONDUIT FITTINGS.

Relating to the discussion in the April 21 issue of the ELECTRICAL REVIEW regarding the requirement in Rules 27, 28 and 29 for removing nonconducting protective coatings from conduits, cabinets and junction boxes, I would state as my opinion that this requirement could be worded a little differently and would express more accurately the intent of the framers of the rules. The requirement reads in effect as follows: "——— coating must be thoroughly removed ——— in order to obtain the requisite good connection."

I think that if the wording were changed as follows, it would express the idea and could then be literally interpreted: "——— coating must be sufficiently removed ——— to obtain the requisite good connection."

It is obvious that the printed rule can not be enforced in its literal sense because to remove the coating *thoroughly* would necessitate either the use of chemical solvents on the metal surfaces to be cleaned, or would require the mechanical removal of the coatings by the use of special tools, such as taps and dies, and possibly grinding machines which would take off the protective coating and also part of the metal to insure *through* removal. This course being quite impracticable, it is then incumbent on the inspector to determine about how much of the coating should be removed to secure the necessary conductivity at couplings and connections. The inspector soon learns that where all joints are made up tight with the ordinary tools in use, ample conductivity is usually secured. The conductivity required at different points in the metal system should be carefully considered. For instance, if the ground connection is made at the center of distribution, then the joints and couplings in branch runs will not be required to carry under normal condition, a current heavier than will be carried by the branch circuit; but if the only ground connection on the conduit system is at the end of one of the branch runs, then all joints and couplings in this branch run may be called upon to carry the current furnished by a breakdown in the feeder and, therefore, this branch run of conduit should be very carefully installed and all the joints and connections very tightly made up so that there will be no heating, even while carrying the maximum current carried by the main fuse. It is obvious also that special care should be observed in removing the coating underneath the ground clamp, since the contact between ground clamp and the conduit should be surely good enough to carry the maximum current without heating.

It would seem to the practical mind more or less unnecessary to enter into an extended discussion or to spend any considerable amount of time in experimental work to determine the relative resistances of the various forms of mechanical joints found in conduit systems, when it is well established that in almost any case, if the metal system is mechanically well installed, the conductivity is almost sure to be more than sufficient to meet all expected requirements. If this were not true fires and burnouts would soon call attention to the fact.

I think I have heard it stated that the Underwriters' Laboratories some years ago undertook to make tests of the resistance in the ordinary locknut and bushing connection between conduit and junction boxes having nonconducting coatings, and where the locknuts and bushings were even moderately tight it was found difficult to make a *poor* connection. In looking over records of fires and burnouts in the city of New Orleans, covering a period of more than ten years, there is found only one small burnout which was due to poor connection in the conduit system, and this was due to the fact that a defectively threaded factory elbow was used, the threads being cut down to such an extent that they did not engage with the coupling at all.

The foregoing discussion seems to answer the question put forward by the Former-President Day. It would seem, in view of the importance which appears to be attached to the matter, that the requirement on this subject should be amended to read in such a manner that the rule could be followed literally.

R. P. STRONG,
Chief Electrical Inspector, Louisiana Fire Prevention Bureau.

The proposition involved in this question is one which seems likely to entirely change the accepted methods in regard to conduit and metal construction

We have not, to be frank, paid very much attention to the cleaning of junction boxes or of iron cabinets, so far as the enamel on the box or pipe is concerned, but the results of close application of the rule referred to can easily be seen.

There seems to be no other way than to use a galvanized or Sherardized conduit, junction box or cabinet, in order to secure a perfect electrical contact between the conduit and the fittings. The cost may be somewhat increased, probably will be, but if our purpose in establishing and revising the Code is to secure a high degree of safety to the persons and property, the mere matter of a few percent increase in cost of these products should not be seriously considered.

H. A. KNIGHT,
Supervisor of Wires, Worcester, Mass.

PROPOSAL OF IRON BUSBARS FOR PANELBOARDS, ETC.

Question 342.—Would busbars made of iron be acceptable on switchboards and panelboards?

Answer 1 (*O*).—Rule 69 covering panelboards does not

specifically require copper for busbars, but does require certain construction methods and compliance with certain test specifications. The question is one which should be referred to Underwriters' Laboratories for determination. Ordinarily the inspector would accept the panelboard if it carried the label of Underwriters' Laboratories, otherwise he would reject it.

Answer 2 (*T*).—I am unable to find a rule in the Code which states that busbars may not be made of iron, but believe that the "spirit and intent" of the Code indicates that only copper may be used for this purpose.

Answer 3 (*K*)*.—No. The Code refers to copper and aluminum conductors only.

Answer 4 (*R*)*.—I see no reason why not, if properly protected from rusting and if of proper carrying capacity to maintain the same temperature rise as with the common material used.

Answer 5 (*P*)*.—I should say not, at least until iron is approved for switchblades and other fittings.

Answer 6 (*F* and *G*).—The use of iron busbars for switch and panelboards is nowhere prohibited by the Code.

Answer 7 (*A*)*.—There is no rule to prevent iron being used for busbars. I should not think it would be acceptable, however, as the bars would be much larger than copper and occupy more space.

Answer 8 (*H*)*.—There would seem to be no objection why they should not be made of iron, provided the quantity used is sufficient to offset the difference in carrying capacity between it and copper.

Answer 9 (*C*).—I would not advise the use of iron for busbars or any other electrical part of switchboard, even if same be treated to prevent oxidation.

Answer 10 (*E*).—I would hardly care to see it used for conducting purposes in any form for inside installations. Where it has been used for knife switches and cutouts the experience has not been good, electrolytic action showing where copper conductors are connected to it.

Answer 11 (*M*).—Busbars made of iron would be acceptable on switchboards or panelboards, provided the area of the iron was in the ratio of conductivities of copper and iron.

Answer 12 (*N*)*.—So far as the Code goes there is nothing whatever to prevent. The case is different for the two locations, panelboards and switchboards.

Panelboards are widely used in buildings of various types of construction and occupancy. There are many places where the physical characteristics of iron would preclude its use, because of space required, electrolytic possibilities, oxidation, etc., and I hardly think it could be used except in special cases.

Switchboards are different, however. They are exposed, under constant supervision and it is perfectly possible to protect all places where copper connections are made so that they shall be dry, in the absence of moisture no electrolytic action being possible. The remaining points are engineering purely, for instance, cross section for requisite conductance, magnetic fields about the busbars and consequent disturbance of instruments, skin effect and hysteresis and eddy currents in the case of alternating-current working, etc., increased space demanded and stronger supporting. All this means added expense and the question boils right down to the economic questions common to engineering decisions.

I should unhesitatingly accept iron busbars on switchboards, if connections to copper were properly protected, and I would not bother much about temperature rise either, for there would be no danger of fire unless the rise was such as to be intolerable from the energy-loss standpoint.

Special Wiring Space for Cabinets.

Question 343.—Rule 70, Section *a*, refers to four circuits. Does this mean four two-wire, four three-wire, four four-wire or what?

Answer 1 (*O*).—Under Rule 70 there is a reference to the detail specifications for cutout boxes and cabinets. These specifications may be obtained by anyone with a proper interest in the subject and they point out that the reference to circuits in the above rule means the ordinary branch circuits, including feeder or subfeeder circuits, whether two, three or four-wire, and also meter loops; but the supply mains and their continuation (where they feed through) are not counted as a circuit.

Answer 2 (*T*).—A general interpretation of that part of the rule as regards circuits could mean four two, three or four-wire circuits as the wording is not clear as it now stands.

Answer 3 (*K*)*.—The spirit of the rule was to do away with bunching the wires in the cabinet where exposed to view and liable to be disturbed, but the Code wording is such as to include four of any of the type of circuits mentioned.

Answer 4 (*R*)*.—We interpret this to mean four four-wire circuits.

Answer 5 (*P*)*.—Rule 70*a* was modified a few years ago to suppress the practice of bunching a number of circuits in utterly inadequate cutout boxes where it became necessary to criss-cross the wires over the face of the cutouts in order to get the wires in at all. I think that the framers of the rule had in mind only the case of two-wire circuits. This is merely a supposition on my part and I would be inclined to rule for or against the three or four-wire circuits as individual cases might require.

Answer 6 (*F* and *G*).—A circuit consists essentially of a feed and a return wire, but in the case of a three-wire circuit there may be two feeding and one return or vice versa, according to balance. We have therefore one wire forming one leg of the circuit with the other two forming the other leg. The same is true of a five-wire two-phase circuit. Following this line of reasoning would permit of four circuits of five wires each, or a total of 20 wires to be used without the use of side gutters.

There is no doubt the rule intended to limit the number of wires which it clearly does not.

Answer 7 (*A*)*.—I should interpret this to mean two-wire branch circuits only. I know of no rule that allows either a three or four-wire circuit for interior work.

Answer 8 (*H*)*.—The wording of Rule 70 is truly very vague, under present conditions of construction. Inasmuch, however, as Rule 28*i* allows the use under special conditions of more wires than are mentioned in the question it would seem fair to assume that, under proper conditions with special construction a larger number of wires could be used.

Answer 9 (*C*).—Rule 70*a* probably means four two-wire circuits, but should be made more definite.

Answer 10 (*E*).—I am of opinion that the rule referred to in this question means four two-wire circuits, my mind being influenced in this by Rule 23*d*, fifth paragraph.

Answer 11 (*M*).—The word "circuit" as used here I would take to mean an individual circuit of any of the usual number of wires. In our territory we have many three-phase, four-wire circuits and I believe it would be proper to allow four such circuits to enter a cabinet where the wires do not leave directly opposite their terminal connections and no side gutters are provided.

Answer 12 (*N*)*.—The rule as it stands says either too much or too little. Either exact definition of what four circuits means should be inserted or else reference thereto should be omitted or modified. As it stands the casual reader does not grasp that the matter is cleared up in the complete specifications, at least to a considerably greater degree than in the rule as it stands *abridged* in the present edition of the Code. This is extremely unfortunate because very frequently we meet cases where a cabinet has to be built specially to fit. There are many places where a mere commercially standardized type is neither suitable nor desirable, and this vagueness means delay and misunderstanding.

QUESTIONS AND ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 388.—Induction Coil for Wireless Set.—I would like to secure data for building a four-inch induction coil to be used on a small wireless set. It is to operate on 110 volts direct current, but if the primary will not stand that voltage. I can probably reduce the voltage to the required amount. I would like to find out the following: Length of primary and secondary coils; number of turns on each; number of layers on each; size of wire for each coil, and amount of wire in pounds for each; also the diameter of core. Can single cotton-covered wire be used on secondary?—R. C. S., Pontiac, Ill.

No. 392.—Depreciation Charge and Cost of Reinstallation.—When setting aside an annual depreciation charge for replacing wornout, obsolete or other unsatisfactory utility equipment, is it customary to provide in this charge for the cost of installing the new apparatus or other equipment, or merely for the cost of purchasing new apparatus for that thrown out? In the latter case, to what account should be charged the cost of setting and connecting the apparatus in place?—B. E. H., Maywood, Ill.

No. 393.—Maintenance of Underground Lines.—What has been the actual cost of the maintenance of underground cables, conduits, etc., for series street lighting at various voltages and different systems, exclusive of electrolier maintenance? What does this maintenance consist of?—T. S. P., San Francisco, Cal.

Answers.

No. 390.—Good Tool Chest for Electrician.—Will some electrician who has a tool chest that he considers entirely satisfactory please give a description of it, or state where such an outfit may be bought. I should also like to know what is considered a good list of tools for an all-around electrician in an industrial plant where he has to do a "little bit of everything."—A. S. N., Plymouth, Mass.

Answer 1.—The number and diversity of tools required by an electrician in the average industrial plant is too great to be kept in a tool chest. The larger and heavier tools, such as pulley and chain block, hoisting ropes, pipe benders, pipe vise, large wrenches, stock and dies, are usually kept in a locked stock or tool room. They are generally furnished by the employer and are common property of electricians, pipe fitters and millwrights. The smaller and more costly tools are usually the property of and furnished by the individual and the tool chest is generally reserved for them.

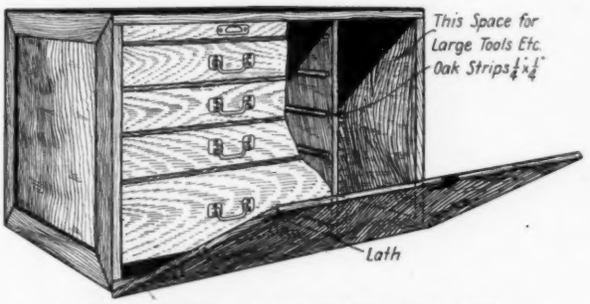
A typical tool chest has two or more trays, each with three to four compartments. Upon the number of tools and the requirements of the labor depends the size of chest, but it is generally too heavy, if not too large, to be taken to the work and may vary in size from 12 by 18 by 24 inches to 24 by 24 by 36 inches. I have seen many factory electricians using a soap box with a piece of leather belt over the top for a handle, in which they carry to and from the job only the tools used on it.

The following list of tools will be found essential in good industrial practice, where the lines of work cover rigid and flexible conduit construction in concrete or fireproof buildings and open work in the so-called slow-burning or semi-fireproof buildings:

Machinists' and claw hammers, breast drill, straight and corner ratchet braces, soldering copper, wire puller, rule, portable vise, splicing pliers, alcohol and gasoline torches, oil can, soldering ladle, pipe benders, standard wire gauge, calipers, tinner's snips.

There should also be included one set each of the following: Cold and wood chisels, twist drills, wood auger bits, pipe wrenches, monkey wrenches, insulated screw drivers, star and pipe drills, side and noncutting pliers.—M. K., Rochelle Park, N. J.

Answer 2.—The accompanying sketch shows a tool chest that I made and which gives perfect satisfaction. It was made of cypress because this is easy to work and light in weight; the choice of wood is up to the maker's taste chiefly. I made the chest from a board 18 inches wide dressed on both sides to ¾ inch thick. I made the chest 18 inches wide, 18 inches high and 26 inches long. I nailed the ends inside the top and bottom, then I nailed the back in, the door also fits inside the top, bottom and ends. The door drops down like a machinist's tool chest. About 8 inches from one end I put a vertical partition in the chest. I then went to the planing mill and got a cypress board four inches wide by one-half inch thick and had a square groove cut in it full length about one-half inch from one edge, the groove being about one-fourth inch wide and one-fourth inch deep. I then got an oak strip that would just fit the groove nicely. I made the sides of drawers from this board; the bottoms I made from one-fourth inch pine, such as obtained from glass boxes. I took a lath and nailed it with the edge of the lath on the bottom of the chest and the face against the partition. I made a drawer 5 inches deep and slid it in on the lath, making the



No. 390.—Design for Electrician's Tool Chest.

bottom of the first drawer the width of a lath from the bottom of the chest. This gives room for a nail-pulling bar and hand saw, small hatchet, or hammer.

I made the next three drawers each three inches deep. After the drawers were all made I nailed the oak strips against the partition and end of chest, these strips fitting into the grooves in the sides of the drawers. The top drawer was quite shallow, only about one inch deep, for keeping small tools. The depth of the drawers can be made whatever is considered suitable. The space between the partition and right end of the chest was left open for receiving bulky tools or supplies, such as a pulley and rope for hoisting motors, etc. If desired, one or more shelves can be put into this space.

Of course the details of the chest can be worked out to suit the needs of the plant. Here where I work it is necessary to have handy tools for all kinds of jobs, consequently this chest is probably larger than needed in most places. After the chest was practically all put together I secured some beaded siding boards and used them for making a reinforcing molding around the end edges, the ends of the boards being mitered. The main part of the box was stained a dark oak finish and the molding and edges painted with lampblack paint; this was then rubbed smooth. I put on brass corner pieces and into the molding I drove a lot of beaded brass tacks. The whole chest was then neatly varnished so that it looks like a piece of furniture. The sketch shows only the principal outlines. The chest complete cost me between $5 and $6. To have had it made by a cabinet maker would have cost probably over $15.—F. B., Anderson, Ind.

New Electrical Appliances

A Review of the Latest Developments and Information Respecting Electrical and Kindred Mechanical Appliances

Bantam Self-Contained Electric-Gas Brazing Torch.

Electrical manufacturers and contractors with small or medium-sized shops where compressed-air equipment is not installed often are at a loss for convenient facilities for brazing small pieces, heating melting pots, annealing and hardening small tools, etc. For these and similar purposes there has been placed on the market a compact combined electric and gas torch, known as the Bantam brazing torch. The outfit consists of small motor-driven blower, that furnishes the air blast, a brazing blow pipe, five feet each of armored air hose and gas hose, and a five-foot connecting

Bantam Combination Brazing Torch, Consisting of Gas Blow Pipe and Electrically Driven Air Blast.

cord with feed-through switch and attachment plug. The motor is a universal machine suitable for use on 110-volt direct or alternating-current circuits. The gas supply pipe should be at least one-half-inch size. Using standard illuminating gas with the outfit it is possible to obtain a temperature of 2300 degrees Fahrenheit, which means extremely rapid work can be done. The gas and air supply can be readily regulated by means of the cocks in each supply hose. The blower is powerful enough to supply air for four burners. This outfit complete is manufactured by the Bantam Manufacturing Company, 64 Pearl Street, Boston, Mass.

Compressed-Air Spraying Outfits with Electric Heater and Electric Exhaust Fan.

The Aeron system for spraying the finish on wood and metal products with compressed air contains several new features which add to the convenience and economy of finishing materials by the spray process.

The outfits are made in a wide range of capacities for handling very small parts or large pieces, such as automobile bodies. The booths are constructed of heavy sheet steel on an angle-iron frame, with wire-glass windows in the sides and top and with a sheet-steel floor. Reflectors and sockets are built in the booths for lights and a portable spotlight is also supplied so arranged that it can be clamped on the frame in any desired position to direct the light upon the work.

The back of the booth is funnel-shaped, the exhaust fan being mounted in the apex of the funnel. This construction gives better exhausting results than can be obtained with a flat rear wall.

The exhaust fan used is of unique design. A one-sixth-horsepower Robbins & Myers motor of special design is used to drive a six-blade 16-inch fan. The motor is completely inclosed to protect it from the fumes, but is provided with thorough ventilation by a stream of cool air which is drawn through the motor by the fan, the intake for this air being provided by a tube which opens outside of the booth. This tube also serves to support the fan and is so arranged that the fan will swing back from the opening to give access to the blades. The wiring for the fan motor is brought up through the air tube. The blade can be removed for cleaning by the removal of a single nut. The exhaust fan is made in one size only, two or more fans, depending upon the requirements, being used in the larger booths.

Where desired the sprayer is equipped with an electric

Finish-Spraying Booth with Electric Exhaust Fan and Turntable.

heater, which heats the air and finishing material before it leaves the spray nozzle.

As shown in the illustration, the outfits can also be furnished with a motor-driven turntable for supporting the work. The speed of rotation is adjustable through a wide range by a friction wheel and disk operated by a one-eighth-horsepower Robbins & Myers motor. The table is started and stopped by a foot pedal. It can also be raised and lowered through a 10-inch range by compressed air acting upon a piston which supports the revolving parts.

The Aeron system is manufactured by the DeVilbiss Manufacturing Company, Toledo, O.

Union Metal Lighting Standards.

The evolution in the design of ornamental lighting standards which has been going on in the last year or so was to be illustrated in an extensive exhibit prepared for the proposed Atlantic City convention of the National Electric Light Association. This exhibit was planned by the Union Metal Manufacturing Company, of Canton, Ohio, and was intended to include a complete line of its lighting standards for business streets, parks, boulevards and residential district lighting. Whereas such ornamental lighting has been done very largely in past years by the cluster system with a group of from two to six lamps clustered at the top of the standard, present practice is to make use of highly efficient single units. This important change in the design of these standards was to be shown in the exhibit referred to, which, for the most part, were to be equipped with the several new types of the General Electric Company's ornamental lighting units, such as the paneled-globe type of luminous arc, a Novalux ornamental unit for lighting with type C Mazda lamps, and Novalux form 8 refractor unit. In the accompanying illustration is shown one of these designs which has proven very popular for ornamental street lighting. This is fitted with the General Electric form 9 Novalux ornamental unit for use with Mazda C lamps.

Special Switching and Outdoor Substation.

An unusual combination switching and outdoor substation with provisions for taking care of several 22,000-volt three-phase lines is shown in the illustration herewith. The steel frame is partially inclosed with tile walls which are in turn covered with cement, thus securing the necessary space for a storehouse, work shop, metering and distribution room.

The high-tension air-break switches are of the three-pole remote-control manually-operated type, capable of being locked in either open or closed position. Lightning protection is secured by means of high-speed sphere-gap graded-resistance arresters in conjunction with long-turn cylinder-form high-power choke coils.

The high-tension equipment shown in this installation is of the "unit type" form manufactured by the Delta-Star Electric Company, Chicago, Ill.

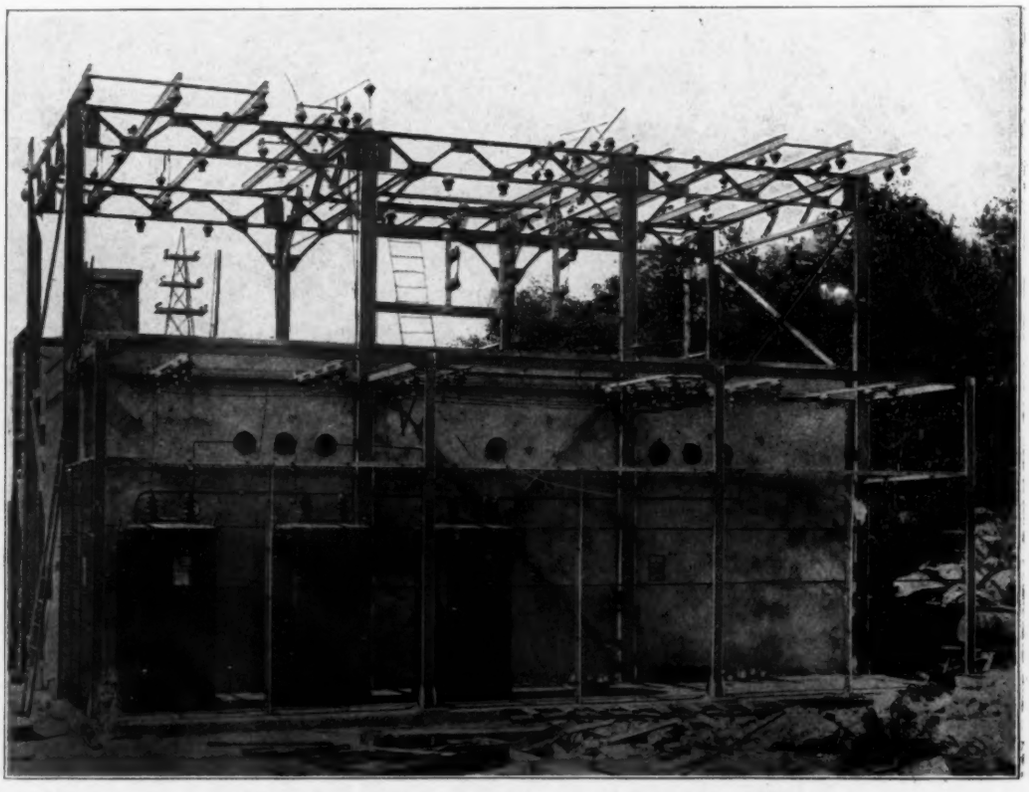
Westinghouse Crane-Protective Panels.

In crane service dependability is a prime essential, as failure of the crane at a critical moment may result in serious and expensive consequences. Hence the need for every protection in crane operation that it is possible to obtain. Maximum protection may be assured by the use of protective panels of the type shown on page 908. This type panel, which is manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., serves a two-fold purpose. It protects crane motors operated by drum or other controllers against injury due to overloads, grounds, short-circuits, sudden return of power after failure of voltage, and the improper operation of the controller, and prevents the premature starting of the motors, thus insuring safety to workmen while inspecting machinery or making repairs.

These Westinghouse crane-protective panels are designed to meet the severe conditions encountered in crane service, and are furnished for one to six circuits, depending upon the number of motors to be protected. They are simple and rugged in construction and thoroughly reliable in operation. The complete panel has mounted on it two single-pole magnetic contactors, an electrical interlock for each contactor, two to seven automatic reset overload relays, and a double-pole, single-throw, knife switch, together with the necessary inclosed fuses. When desired, an inclosing cover is furnished, making the panel dustproof.

The magnetic contactors are operated from a push-button station mounted in the crane cab. Due to the electrical interlocks, the contactors will not close until the starting

Popular Design of Ornamental Street-Lighting Standard.

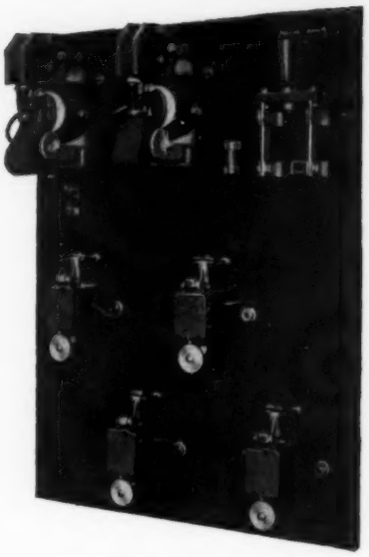


Switching and Outdoor Substation for Three-Phase, 22,000-Volt Lines.

push button is pressed, and after closing they will not open when the push button is released, unless the contactor coil becomes de-energized by the operation of the overload relays or by the opening of the main switch. Should the current in any circuit rise to a value corresponding to the setting of the relay in that circuit, the relay opens the control circuit through the shunt operating coils of the magnetic contactors, which then open the main circuit.

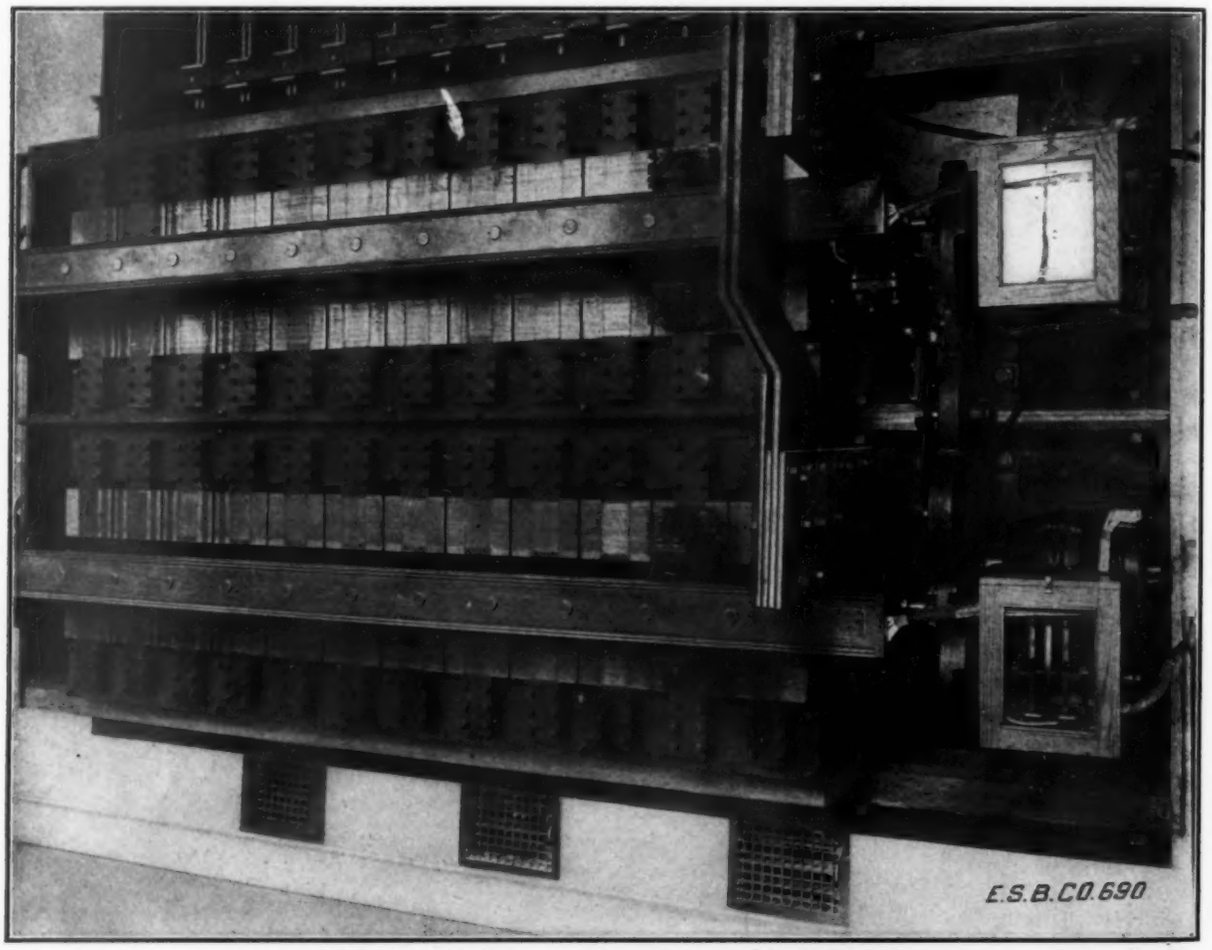
When only one circuit is to be protected, an overload relay is placed in each side of the line. When more than one circuit is to be protected, an individual relay is placed in one side of the line of each circuit and a cumulative relay in the common side of the main circuit. Each individual relay is set to operate at the overload current value of its own circuit, while the cumulative relay is set for the integrated current value of the total load. Both sides of the line are thus protected by overload relays, and failure of the relays to operate, due to grounded wires, is made impossible. After operating, the relays are closed automatically by gravity reset. The setting which determines the current value at which the relays will operate can be regulated by a knurled nut at the bottom of each relay.

The knife switch, which is utilized for connecting and disconnecting the protective panel to the main line circuit, is equipped with a safety device permitting it to be locked in the open position by ordinary padlocks. This insures safety to workmen while making repairs on the crane, as the switch cannot be closed until the last padlock has been removed.



Protective Panel for Electric Cranes.

The panel may be mounted in any convenient place, and when desired pipe frame or mounting brackets are furnished.



Rear View of the Largest Storage-Battery End-Cell Switch Ever Built.

This type of switch was to have formed a conspicuous feature of the exhibit planned by The Electric Storage Battery Company, of Philadelphia, for display at the Atlantic City convention of the National Electric Light Association. This switch has a continuous carrying capacity of 10,000 amperes and a momentary capacity of 40,000 amperes. The two traveling sections of the switch are operated by electric motors that are remote-controlled. The contact can move from one end to the other of its entire travel in 15 seconds. Switches of this type have recently been furnished to the large central-station companies in New York, Detroit and Chicago.

Activities in the Trade

Estate Stove Company, Hamilton, O., has published catalog No. 10, descriptive of its line of electrical ranges.

V. V. Fittings Company, Philadelphia, Pa., is sending to the trade a folder descriptive of its line of safety switches.

Hughes Electric Heating Company, 5660 West Taylor Street, Chicago, Ill., has issued a revised price list of its electric ranges, hot plates, etc., effective June 1.

Gordon Lamp Company, 76 Jackson Street, Orange, N. J., has been organized to manufacture electric lamp bulbs. S. Fred. Wright is at the head of the company.

General Electric Company is moving its New York City offices from 30 Church Street to the Equitable Building, 120 Broadway, where it will occupy the entire twentieth floor.

Crocker-Wheeler Company, Ampere, N. J., has issued bulletin No. 177, on its Form W 220 or 230-volt, direct-current rolling-mill motors, and bulletin No. 178, on equipment for three-wire, direct-current distribution.

Radium Luminous Materials Corporation, 123 North Third Street, Newark, N. J., manufacturers of radium lighting specialties, will build a new two-story plant on Alden Street, Orange, N. J., to cost about $12,000.

Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, Ill., has published a booklet describing its lines of fuses, contact clips, cut-outs and fuse boxes for use on automobile starting and lighting equipment.

Bijur Motor Lighting Company, Sixteenth Street, Hoboken, N. J., has recently increased its capital from $650,000 to $2,000,000 for extensions. The company recently removed to a new plant and is now operating at full capacity.

McEwen Brothers, Willsville, N. Y., have prepared a bulletin descriptive of their high-compression oil-engines, which are of the horizontal, four-stroke-cycle type operating on the Diesel principle and burning any kind of heavy crude oil.

Remmert Electric Company, St. Louis, Mo., recently secured a five-year lease of store space in the Plankinton Arcade, Milwaukee, Wis., and will open a branch store there. The company also has branches in Chicago, Kansas City and Springfield.

Victor Electric Corporation, manufacturer of motors and automobile electric supplies, has leased property at 218-228 South Robey Street, Chicago, Ill., on which it will erect a four-story and basement building, 120 by 130 feet, for manufacturing purposes.

Federal Electric Company, Pittsburgh, Pa., manufacturer of a complete line of switch boxes, outlet boxes, cabinets, push buttons and receptacle plates, has appointed S. Robert Schwartz & Brother, 729 Broadway, New York City, as its agents in the Eastern territory.

Packard Electric Company, Warren, O., has established a district office in the San Fernando Building, Los Angeles, Cal., in charge of J. G. Monahan. This office will handle all of the territory south of Fresno and also the state of Arizona on all products of the transformer department.

Western Electric Company has prepared an attractively bound folder which contains material on its window display service for electrical dealers. Illustrations and subject matter show how the dealer can set up displays of the different lines of appliances as well as composite displays which carry seasonable significance. The folder will be found to be a valuable asset to dealers in making the best of their window-display space.

Duquesne Electric & Manufacturing Company, Bessemer Building, Pittsburgh, Pa., has succeeded the Service Supply & Equipment Company, also of Pittsburgh, and will operate as specialists in new and second-hand equipment and electrical repair work.

National X-Ray Reflector Company, 235 W. Jackson Boulevard, Chicago, Ill., has issued a booklet on "The Influence of Lighting on Church Attendance," which gives illustrations of a number of installations and demonstrates the advantages of illuminating churches from concealed sources.

Bonus for Employees of the Splitdorf Electrical Company.—The Splitdorf Electrical Company, Newark, N. J., is now operating under a system of permanent bonus payments to employees in all departments. The distribution is made on a basis of about 10 per cent of the earnings of employees for the preceding month, including about 1600 employees, both time and piece-workers at the plant. It is estimated that the aggregate bonus to all employees will total about $150,000 yearly.

Stow Manufacturing Company, Binghamton, N. Y., has issued bulletins Nos. 101 and 102. The former of these deals with the company's electric tools of the portable, semi-portable and stationary types. These include drills, buffers, grinders, motor-driven utility tools, etc. The second bulletin describes the various types, sizes and attachments of the Stow flexible shaft which is used very extensively in connection with portable or semi-portable tools. Each of these bulletins is well illustrated and is issued in miniature size, making it very convenient for reference. Each bulletin is complete, however, on the line that it covers.

H. W. Johns-Manville Company, New York City, had planned a comprehensive display for the exhibition at the proposed Atlantic City convention of the National Electric Light Association, many new products and improvements being featured. One phase of this display particularly promised to be of exceptional educational value, as it showed a bank of Noark universal meter-protective devices working under actual service conditions. Among the other products to have been displayed in the 1,200 square feet floor space reserved for the company were fire extinguishers, subway boxes, service switches, inclosed fuses, fiber conduit, asbestos wood, asbestos roofing, asbestos shingles, molded insulations, Niagrite cable insulation, tapes and a new Noark service switch for use in industrial plants.

The Bleadon-Dun Company, Chicago, Ill., manufacturer of the Violetta and other therapeutic apparatus, has recently moved to greatly enlarged and improved quarters at 11-17 South Desplaines Street. A large display room has been fitted out where the apparatus can be seen and demonstrated. The new quarters give the company a capacity for producing 100 machines a day. The company has been steadily enlarging its business and finds that the Violetta generator is meeting a popular demand for a simple, compact and effective electrical equipment employing high-frequency violet rays. Not only are sales increasing in this country, but a large number of machines have been exported, particularly to South America and India. The apparatus is going into the hands not only of physicians, barbers and hair-dressing establishments, but also into the homes. The head of the company, John Bleadon, is a graduate of the University of Chicago, class of 1910, and has had a very successful career in the five years that he has been engaged in the electrical business. He began

this work with a cash capital of $18. Finding the need for an instrument of this kind because other apparatus of this type was very cumbersome and difficult to control, he designed the self-contained Violetta device. This has been improved from time to time and now is a very powerful and yet simple apparatus. Not only are medical supply houses handling the equipment in increasing amounts, but also electrical jobbers and local electrical dealers, as well as central stations, since the outfit can be used on ordinary 110-volt circuits, either direct current or alternating current. The company is now branching out into the manufacture of X-ray machines and other electrotherapeutic apparatus for physicians' use.

Personal and Biographical

BRUCE CAMERON, who was elected president of the Missouri Association of Public Utilities at the convention of that association last week, is superintendent of transportation, United Railways Company, St. Louis.

Bruce Cameron.

Mr. Cameron has been prominently identified with the affairs of the Missouri association for a number of years, and held the office of first vice-president prior to his election as president.

A. W. BURCHARD was elected an additional member of the board of directors of the General Electric Company at the annual meeting of the stockholders held on May 8. All of the retiring directors were re-elected.

A. S. CUMMINS, formerly manager of Northern States Power Company, Stillwater (Minn.) division, has been transferred to the New York office of H. M. Byllesby & Company. B. O. LUND, superintendent of the company, has been appointed as his successor.

KELLOGG BIRDSEYE has resigned as treasurer and general manager of the George C. Lynch Company, 236 Fifth avenue, New York, manufacturer of electric lamps. C. W. ANDERSON, Jr., has resigned as secretary. C. H. WARFIELD has been appointed secretary and treasurer of the company to fill the vacancies.

S. R. BERTRON has been appointed a member of the commission to Russia by President Wilson. Mr. Bertron is connected with the firm of Bertron, Griscom & Company, New York City, which is interested in the United Gas & Electric Corporation, the New Orleans Railway & Light Company, the International Railway and other public utility properties.

C. J. LITSCHER, of the C. J. Litscher Electric Company, Grand Rapids, Mich., has been elected president of the Automobile Business Association.

W. L. MILLER, manager of the Interstate Light & Power Company at Galena, Ill., has been appointed park commissioner by the mayor of Galena.

WILLIAM J. LESCURE, Harrisburg, Pa., has been elected president of the Cumberland Valley Telephone Company, also of Harrisburg, succeeding HENRY M. TRACY, resigned.

W. J. McDOWELL, formerly with the sales organization of Walker Vehicle Company, has resigned to again join the sales force of the General Motor Truck Company, Chicago.

W. S. MURRAY, of the engineering firm of McHenry & Murray, New Haven, Conn., which has been dissolved by mutual consent, will hereafter devote his entire time and attention to the interests of the Housatonic Power Company, of which he is president.

J. F. OWENS, manager of the Muskogee (Okla.) Gas & Electric Company, has been selected as a candidate for president of the Muskogee Rotary Club by the nominating committee. Mr. Owens has also been selected as a team captain to represent the Rotary Club in the Y. M. C. A. campaign for new members.

C. LOOMIS ALLEN, Syracuse, N. Y., and HORACE E. ANDREWS, president of the New York State Railways, Syracuse, have been appointed members of a committee to devise plans for increasing the revenues of electric railway lines in the state. Mr. Allen is associated with the Empire United Railways.

W. F. RABER, general manager of the Arkansas Valley Railway, Light & Power Company, Florence, Colo., is cooperating with the government in an effort to secure volunteers for service in France to work on the construction and maintenance of railways. During the first day 20 men enlisted at the various offices of the company, each of which has been made a recruiting station.

C. P. DONAHUE has been appointed sales manager of the Electric Materials Company, North East, Pa. Mr. Donahue has been with the company since February, and prior to that was employed by the Westinghouse Electric & Manufacturing Company at East Pittsburgh for 14 years, during which period he had several years of practical shop work, the remainder of the time being connected with the sales department.

H. C. CUMMINS, formerly assistant general manager of the Northern States Power Company, has been transferred to the Chicago office.

GEORGE W. NEFF has been placed in charge of Eastern territory for the John M. McGovern Company, of Cincinnati, O., and will maintain headquarters at 50 Church street, New York City.

EDWARD W. SMITH, chemical engineer, the Electric Storage Battery Company, Philadelphia, Pa., tendered an interesting address on storage batteries, showing the present range of accomplishments, before the members of the Philadelphia Section of the American Chemical Society, May 17.

OBITUARY.

AUGUSTUS T. CLARK, who was for many years treasurer of American Circular Loom Company, died at his residence in Newton Center, Mass., May 8. Mr. Clark was born in Wilmington, Del., September 3, 1854, but when a boy his parents moved to Massachusetts, making their home in Lynn, and in later years in Newton Center. Mr. Clark spent five years in explora-

A. T. Clark.

tion in South America as a mining expert. Upon his return to the United States he became interested in the American Circular Loom Company, of which company he was one of the officers. Mr. Clark was a member of the Manufacturers' Club, the Jovian Order, the Exchange Club of Boston, the Brookline Country Club, and the Boston Chamber of Commerce. He is survived by his widow and one daughter.

Current Electrical News

WEEKLY RECORD OF CONSTRUCTION ACTIVITIES

EASTERN STATES.

YARMOUTH, ME.—The Yarmouth Lighting Company has made a deal whereby it will secure energy in bulk from the Cumberland County Power & Light Company. A transmission line will be erected by the latter company to connect with the lines of the Yarmouth company.

CONCORD, N. H.—The Concord Electric Company has been granted permission by the Public Service Commission to purchase the holdings of the Pennacook Electric Light Company for $60,000.

TURNERS FALLS, MASS.—The Turners Falls Power & Electric Company is planning the erection of a tower line over the Connecticut River in Springfield, Mass.

NEW HAVEN, CONN.—Residents on Grand Avenue and on Orange Street have petitioned the street-lighting committee for improvements to the lighting system on those streets.

CORNING, N. Y.—The State Legislature has passed a bill authorizing the incorporation of the Lamoka Electric Water Corporation of Corning and giving it the right to develop a water-power site on Mud Creek. It is understood the company will construct a dam near Savona, a canal and pipe line from Wayne to Lake Keuka, and a power plant on Lake Keuka near Grove Springs.

NEW YORK, N. Y.—The New York Edison Company has filed plans for the erection of a new one-story transformer station on West Twenty-seventh Street, to cost about $35,000.

CAMDEN, N. J.—The Delaware & Atlantic Telegraph & Telephone Company will build a two-story addition to its exchange plant at Fifth and Market Streets, to cost about $40,000. T. B. McClain is district manager.

CLIFTON, N. J.—The Borough Council has ordered the advertising of bids for lighting the city streets.

LAMBERTVILLE, N. J.—The National Utilities Company is planning extensions and improvements in its electric plants and system at Dover and Newton. Harold R. Wilbus is the local manager.

NEWARK, N. J.—The Board of Freeholders has taken bids for immediate improvements in the power station at the county penitentiary, Caldwell, to include new engine, generator and switchboard and extensions in the boiler plant. Runyon & Carey, 845 Broad Street, are the consulting engineers.

PLEASANTVILLE, N. J.—New motor-driven pumping machinery will be installed for two new private water systems on the properties of J. P. Anderson and Isaac H. Nutter. Harrison, Mertz & Emlen, Commercial Trust Building, Philadelphia, Pa., are engineers.

TRENTON, N. J.—The City Commission has completed the installation of a conduit system in Mahlon Stacy Park, and is planning the immediate placement of lighting standards and inauguration of the system. Commissioner Burk is in charge.

BETHLEHEM, PA.—The Bethlehem City Water Company is planning the installation of new electric pumping machinery with a capacity of about 10,000,000 gallons.

COALPORT, PA.—The Public Service Commission has ordered the Coalport Heat, Light & Power Company to install and furnish 24-hour service throughout its territory.

EASTON, PA.—The Pennsylvania Utilities Company has received a contract from the Warren Manufacturing Company for furnishing electric power for the operation of its paper mills at Milford, Warren, Hughesville and Riegelsville. The company will immediately commence the construction of a new 33,000-volt transmission line to these points for the service, while the paper works is arranging for the installation of necessary equipment for the new central-station supply.

HARRISBURG, PA.—The City Council has adopted an ordinance authorizing the calling for bids for lighting the city streets and municipal buildings, to be received about June 1.

HAZLETON, PA.—The Harwood Electric Company has commenced the installation of a system at Conyngham for light and power service. It is planned to inaugurate the service on September 1.

JOHNSTOWN, PA.—A controlling interest in the Citizens' Light, Heat & Power Company has been secured by H. D. Walbridge & Company, bankers, 14 Wall Street, New York City. It is said that the company will be reorganized and extensions and improvements made in the plant and system.

MILLERSVILLE, PA.—The Edison Electric Company, Lancaster, is now furnishing electric power to the Lancaster & York Furnace Street Railway Company for operation. The system extends from Millersville to Pequea-on-the-Susquehanna, about 12 miles.

PHILADELPHIA, PA.—The Theodore Presser Company, 1712 Chestnut Street, will build a one-story power plant, 50 by 100 feet, at its printing plant, Yeadon, to cost about $30,000.

PHILADELPHIA, PA.—Trustees of St. Vincent's Home are taking bids for the erection of a power plant, 73 by 79 feet, at the new four-story home to be constructed on Lansdowne Avenue.

PHILADELPHIA, PA.—The Treen Box Company, Memphis and Tioga Streets, will build a one-story power house, about 30 by 60 feet, in connection with a new two-story manufacturing plant.

PHILADELPHIA, PA.—The Philadelphia Electric Company will build a new one-story boiler plant at its electric station, Robbins Street and the Delaware River, to cost $60,000. The structure will be about 50 by 104 feet.

PHILADELPHIA, PA.—The Scofield Engineering Company, Commercial Trust Building, is preparing plans for a one-story power plant, about 200 by 300 feet, to be erected at the plant of the Dunnellon Phosphate Company, Fernandina, Fla.

PHILADELPHIA, PA.—The Bureau of Health and Charities is taking bids for the construction of a one-story power plant, about 60 by 90 feet, in connection with other buildings, at the Byberry Hospital. Philip H. Johnson, Land Title Building, is the architect.

PITTSBURGH, PA.—The Pittsburg, Harmony & New Castle Railway Company will build an addition to its power plant at Harmony Junction.

PITTSBURGH, PA.—The Central District Telephone Company has acquired property at Highland and Rural Avenues for a consideration of about $70,000 for the erection of a new telephone exchange station.

READING, PA.—An engine plant for factory operation will be installed by Simon & Sherman, 135 Grape Street, in their new packing house to be erected at Chestnut and Second Streets.

READING, PA.—The Metropolitan Electric Company has acquired property adjoining its plant at West Reading for proposed extensions. Additions have been made in the boiler house for two new 1,000-horsepower units.

SCRANTON, PA.—The Maccar Truck Company is considering the erection of a new one-story reinforced-concrete power plant for factory operation.

NEW CASTLE, DEL.—The Penn-Seaboard Steel Corporation has installed an electric charging machine at its Baldt works. It is said that the plant handles five tons of metal in five minutes, doing the work of about 40 men.

BALTIMORE, MD.—During the past year the City Electrical Commission has installed about 516,400 duct feet of electrical conduit for the elimination of aerial lines, or in linear measurement, 172,154 feet. The department is planning extensive operations during the present year. Raleigh C. Thomas is chief engineer.

BOWLING GREEN, VA.—The Bowling Green Light & Power Company has been incorporated with a capital of $10,000 by L. E. Martin and B. F. Borkey and will erect an electric plant to furnish service in this vicinity. Construction work will be started as soon as materials can be secured.

BEVERLY, W. VA.—The Beverly Telephone Company has been incorporated to operate a local system. H. H. Daniels and J. J. Doen, Beverly, are heads of the company.

CHARLESTON, W. VA.—In connection with the new armor-plate and projectile plants to be erected by the War Department, a power plant to cost about $175,000 will be constructed. The city has donated a tract of 200 acres for the works.

ATLANTA, GA.—The Southern Railway Company will erect two copper telephone circuits between Spencer and this city, a distance of about 300 miles. The work will be done under the supervision of the superintendent of telegraph, Charlotte, N. C.

ATLANTA, GA.—The Georgia Railway & Power Company will build a 110,000-volt substation to feed its Stone Mountain line at 38,000 volts, and install two banks of three 1,000-kilovolt-ampere transformers with one spare for each bank. The length of transmission system from Norcross to Stone Mountain is ten miles.

CHAUNCEY, GA.—The Southern Utilities Company, of Eastman, Ga., has secured a municipal franchise to construct and operate an electric lighting system here.

FOLKSTON, GA.—J. W. Buchanan will develop a water-power site and supply electricity in Folkston for lighting and manufacturing purposes.

NORTH CENTRAL STATES.

CANTON, O.—The City Council has authorized the installation of an electric lighting system on Woodland Avenue in that city.

GUNNERSVILLE, O.—The Dayton Power & Light Company has secured right of way for the erection of a transmission line from Xenia to this place, about 15 miles.

ST. MARYS, O.—Contracts approximately $37,000 for the construction of the municipal light and waterworks plant and distribution system, including ornamental street lamps, were awarded by the Board of Control to the Skeidon Engineering Company and the National Supply Company, Toledo, and Charles I. Zahn, Detroit.

YOUNGSTOWN, O.—Directors of the subsidiary companies of the Mahoning & Shenango Railway & Light Company have decided to merge all the ten companies into one, to be known as the Shenango Valley Light Company.

BLOOMFIELD, IND.—The Indiana Power & Water Company, of Bloomfield, has petitioned the Public Service Commission for authority to purchase the following electric light properties at the prices indicated: Vincennes Electric Light Company, $75,062.40; City Electric

Lighting Company of Vincennes, $525,-437; Continental Utilities Company, at Petersburg, $37,850, and at Dugger, $30,-800. To finance this merger of properties the company has asked for authority to issue bonds in the sum of $452,000, capital stock to the amount of $147,000 and notes in the sum of $170,000. H. L. Clark is president of the petitioning company.

HAMMOND, IND.—Application has been made to the Indiana Public Service Commission by the Northern Indiana Gas & Electric Company for authority to issue $609,000 of its bonds and $93,000 notes; also $151,000 bonds of the Indiana Lighting Company, which are now held by the Northern Indiana Gas & Electric Company. The proceeds are to be used for refunding, improvements and extensions.

ODON, IND.—The Indiana Power & Water Company, of this city, which is erecting a large power plant at Edwardsport, Knox County, has filed a petition with the Daviess County Commissioners asking a franchise granting the company the use of highways, bridges and water courses of the country for the purpose of setting poles, wires and other appliances to convey and distribute electricity, to erect, maintain, purchase and operate an electric light and power plant and distribution system in Plainville and to sell electricity to the inhabitants and other unincorporated parts of the county for light, heat and power purposes.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company has increased its capital stock from $3,500,000 to $5,000,000.

GALESBURG, ILL.—The Galesburg Railway, Lighting & Power Company will increase its capital stock from $3,500,000 to $4,000,000.

GIBSON CITY, ILL.—The City Council will proceed to build a $22,000 electric plant, for which bonds have been authorized.

LINCOLN, ILL.—Bids for installing an ornamental lighting system in Lincoln and Wyatt Avenues are being received by the City Commissioners.

LINCOLN, ILL.—Voters here will decide June 19 on the proposition whether the city shall acquire, construct and operate the Lincoln street railway and issue $30,000 bonds for the purpose.

MEDORA, ILL.—T. L. McCord is president of the construction company which has the contract to construct 42 miles of electric railway from Medora to Ottawa and from Prairie Center to Ellisville. W. C. Viltum is promoter of the project.

SPRINGFIELD, ILL.—Over $600,000 will be expended to place lighting, power, telephone and telegraph wires underground in the business district. Commissioner J. E. Smith is in charge of the plans.

BOYNE CITY, MICH.—The Boyne City Electric Company is making a number of extensions to the local street-lighting system.

IRON MOUNTAIN, MICH.—The Michigan State Telephone Company will expend more than $50,000 in the district immediately surrounding Iron Mountain during the next several months. L. Green, the construction engineer, will make his headquarters at Iron Mountain.

WEST MILWAUKEE, WIS.—A special election will be held here to determine whether the village shall install its own street-lighting system. Arthur J. Sweet, consulting engineer, has submitted figures showing an estimate of the costs of a system.

MADISON, WIS.—Permission has been granted to the Wisconsin Valley Electric Company to issue $1,337,500 bonds by the Wisconsin Railroad Commission. The proceeds will be used to refund $564,000 of bonds of the Wassau Street Railway and notes of the Wisconsin Valley Electric Company, the balance to provide for new construction.

SCHLEISINGERVILLE, WIS.—The village has sold its transmission line to Hartford to the Milwaukee Electric Railway & Light Company, which is extending its lines in this section.

NEW ULM, MINN.—A number of residents of the Wallachei district have asked the City Council to extend the electric lighting system to furnish service in that district.

CENTERVILLE, IOWA.—The Centerville Light & Traction Company has purchased a number of small central-station companies in the immediate vicinity of Centerville and expects to build 13,200-volt transmission lines connecting these plants with its power station. F. S. Payne is general manager of the company.

DES MOINES, IOWA.—Foundations have been started for the installation of the new 5,000-kilowatt turbo-generator at the Des Moines Electric Company's plant. According to General Manager M. G. Linn, the company has other plans for future development, most of which probably will be postponed for the future on account of the shortage of materials. The installation of the new turbine and a new battery of boilers will call for another switchboard and this also has been ordered. The new board will cost $30,000. When completed the additions to the plant will increase the capacity by 45 per cent.

MANSON, IOWA.—A special election recently was held here for the purpose of voting on the establishment of a municipal electric light and power and heating plant. The vote resulted in a majority of 41 for the light and power plant and a majority of one for the heating plant.

MT. VERNON, IOWA.—The Wapsie Power & Light Company, of which W. S. Tasker is president, is completing the preliminary plans for another extension of its service lines, a circuit of some eight or nine miles out of West Branch and which will take in the villages of Centerdale and Springdale.

DUDLEY, MO.—The city is considering plans for the construction of an electric lighting system.

RICH HILL, MO.—The city is considering the installation of additional generating equipment in electric lighting plant.

ARGONIA, KANS.—The Western Sumner Light & Power Company, of this city, and the Tri-County Light & Power Company of Norwich, have asked authority from the Public Utilities Commission to operate in the towns of Norwich, Milton, Viola, Mayfield and Argonia.

McPHERSON, KANS.—Bids are being received by Arthur Gorbesbeck, superintendent of the Water and Electric Department, for furnishing and erecting the following in accordance with plans on file in his office: A 250-horsepower watertube boiler and 500-horsepower open heater with all small piping and attachments, certified check of $1,000 to accompany bid; a direct-connected steam-driven generating unit of not less than 300-kilovolt-amperes capacity and switchboard panel with instruments and switches all installed and wired complete, certified check of $1,000 to accompany bid.

VALLEY CITY, N. D.—Valley City has entered into a 20-year contract with the Dakota Engineering & Construction Company, of Grand Forks, for the purpose of furnishing electricity for lighting Sanborn, Rogers and Dazey. The company will build the transmission line and furnish energy to the customers along the line, and the three different towns. Construction work will start at once and the line, which will be about 35 miles long, will be completed so as to be ready for service next fall.

DATES AHEAD.

Electric Power Club. Spring meeting, Homestead Hotel, Hot Springs, Va., June 11-14. Secretary, C. H. Roth, 1410 West Adams Street, Chicago, Ill.

Electrical Contractors' Association of Pennsylvania. Annual convention, Philadelphia, Pa., June 19-21. Secretary, M. J. Sellers, 1518 Sansom Street, Philadelphia, Pa.

American Institute of Chemical Engineers. Semi-annual meeting, Buffalo, N. Y., June 20-22. Secretary, J. C. Olsen, Cooper Union, New York City.

American Institute of Electrical Engineers. Annual meeting, Hot Springs, Va., June 26-29. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

Ohio Electric Light Association. Annual convention, Breakers Hotel, Cedar Point, O., July 16-20. Secretary, D. L. Gaskill, Greenville, O.

SOUTH CENTRAL STATES.

ADAIRVILLE, KY.—The Adairville Lighting Company has let a contract to the Electric Equipment Company, Nashville, Tenn., for the installation of the city lighting system, which will begin operations with a crude-oil engine. R. E. Brian, president of the company, announced that the contracts for construction of the hydroelectric plant on the south fork of Red River would be let about October 15. It will call for a water turbine, to operate on a six-foot head, about 100 horsepower, together with a 2,300-volt, three-phase, 60-cycle generator, belted type, etc. A three-mile transmission line will be erected and power furnished to surrounding communities, farms, etc. Prices on the hydroelectric equipment are asked.

CAMPBELLSVILLE, KY.—The recently incorporated Campbellsville Electric Light & Power Company will install a hydroelectric plant to cost $40,000. It is to involve construction of a dam 100 feet long and 25 feet wide. Howard M. Hesser is engineer.

DIXON, KY.—Local citizens are organizing a company to install an electric lighting plant in the city. The cost of the plant is estimated at $4,000.

HARDINSBURG, KY.—The Hardinsburg Mill & Elevator Company has purchased the interest of Frank DeHaven in the Hardinsburg Electric Light Company and is now sole owner.

HARLAN, KY.—A second electric lighting franchise has been passed by the City Council.

LA GRANGE, KY.—The Kentucky Utilities Company has announced its willingness to purchase an electric lighting and power franchise for the city and to make a contract for street lighting. The franchise as drawn provides for a 12-cent rate, the utility company to supply the meters. Service is to be inaugurated on or before December 1, next.

LOTHAIR, KY.—The Kentucky River Power Company, of Hazard, which recently completed the installation of a power plant here, will erect transmission lines into the Lotts Creek district, to furnish service to coal-mine operators there.

MAYSVILLE, KY.—Cochran Brothers have perfected plans for erection and equipment of power plant here, in which will be installed a 750-kilowatt turbo-generator. The equipment has been contracted for. Contracts have been closed by which the entire capacity of the plant will be taken by the January & Wood Company, cotton mill operators, the Maysville Gas Company and the Maysville Street Railroad & Transfer Company. The January & Wood Company will convert its plant to electric drive, exhaust steam required by this mill to be provided from the power house. The Maysville Gas Company, which has the city franchise, will change its distribution system from two-phase to three-phase to correspond to the new plant, which is 2,300-volt, 60-cycle, three-phase alternating current. It is proposed that the new plant will be in operation by the first of next year.

PADUCAH, KY.—The City Commission will ask F. W. Ballard, consulting engineer, of Cleveland, O., for an opinion as to the size of the bond issue which the city should vote on for conversion of its street-lighting plant to a municipal plant capable of taking care of the needs of the city. The commission has decided to submit the matter of a bond issue to the people. Commissioner W. A. Gardner insists that an issue of $80,-000 would be sufficient, while the sum named by another engineer as desirable was $185,000.

WHITESBURG, KY.—W. C. Daniels, of Monica, Ky., has purchased the lighting franchise offered for sale by the city. He will begin construction of a plant at once and proposes to build one of sufficient capacity to supply the power requirements of a number of the surrounding coal mines.

OOLTEWAH, TENN.—The James County Power Company will be organized to furnish electricity, power to be secured from the Ocoee plant of the Tennessee Power Company. A transformer station will be erected.

FERNWOOD, MISS.—The McComb-Magnolia Light & Railroad Company has completed negotiations with the Fernwood Lumber Company for the purchase of a site for the erection of a power

plant. The construction of the plant will begin at an early date and it is planned to have the plant in operation by November 1.

McGEHEE, ARK.—The McGehee Water and Light District is installing a second 120-horsepower Diesel oil engine in the power house here. This engine and its auxiliary equipment is the second unit of the local plant. An addition to the power house is being erected.

PONCHATOULA, LA.—The Hammond Ice, Light & Bottling Company of Hammond, La., has purchased the Ponchatoula Ice & Light Company's plant and plans to make improvements.

HEALDTON, OKLA.—Machinery for the construction of a plant for the Healdton Ice, Light & Power Company, purchased from the Inter-State Sales Agency, of Oklahoma City, is now in transit. The latter concern has the contract to erect the plant and for the wiring of 18 business blocks in the town. The officers of the company are C. V. Miller, president; N. A. Jennings, vice-president, and R. E. Martin, secretary and treasurer.

KINGSTON, OKLA.—The Kingston Ice & Light Company has been incorporated with a capital of $20,000 by George F. Blethen, J. F. Wilkins and H. F. Benson, of this city, to provide electric service in this community.

DALLAS, TEX.—J. F. Strickland and C. W. Hobson, who have been voted franchises to operate light and power systems and electric traction lines in this city as representatives of the General Electric Company, have as yet made no announcement as to the organization or financing of the properties. It is stated, however, that as soon as this is accomplished, an extensive program of improvements will be announced. These properties have just been inspected by Gordon Abbott, of Boston, chairman of the board of the Old Colony Trust Company and president of the United Electric Securities Company; J. A. Trawick, of New York, vice-president of the United Electric Securities Company; O. D. Young, of New York, vice-president of the General Electric Company, and S. Z. Mitchell, of New York, president of the Electric Bond & Share Company.

WESTERN STATES.

BILLINGS, MONT.—Articles of incorporation have been filed by the Billings Railway, Light & Power Company as a preliminary step toward electrification of the local street-car system. An interurban line to Laurel and other places may be constructed.

LEWISTOWN, MONT.—The City Council passed an ordinance covering a ten-year contract with Washington-Idaho Water, Light & Power Company for furnishing electrical energy for street lighting and power for pumping water. Provision is to be made for establishing an ornamental lighting system in Main street.

RONAN, MONT.—W. B. McDonald, of the Northern Idaho & Montana Power Company, has applied for a 50-year franchise for light and power in Ronan. In the event of getting the franchise the Northern Idaho will extend the power line down the east shore of Flathead and on to Ronan. The company has already been granted a permit to run its line alongside the county road on the east side of the lake.

DOUGLAS, ARIZ.—Plans are under consideration for running a power line from Elephant Butte dam to Kingston to furnish cheap power for mine operators in that section. The line as planned would run via Chino, Silver City, Kingston and Tyrone, N. M.

TUCSON, ARIZ.—The Western Union Telegraph Company has closed a ten-year lease for property at 18 East Congress Street in which will be installed equipment costing several hundred dollars.

OHESAW, WASH.—Steps have been taken to secure electric lighting service for this place.

OLYMPIA, WASH.—The Puget Sound Traction, Light & Power Company has applied to the County Commissioners for permission to construct a transmission line from the Nisqually River to the Log Cabin between Olympia and Tumwater. The hearing of the application has been set for June 4.

SEATTLE, WASH.—The Allis-Chalmers Manufacturing Company was awarded the contract for the turbine and exciter units of the proposed 10,000-kilowatt addition to the city's steam power plant at $147,400.

TACOMA, WASH.—The Wheeler Osgood Company has been granted permission to install an electric transmission line on Railroad Avenue.

TACOMA, WASH.—A 50-year franchise has been granted the Puget Sound Traction, Light & Power Company to maintain a transmission line along certain public highways in Pierce County.

PORTLAND, ORE.—The City Council will not submit the $1,777,000 bond issue for a municipal electric light plant at the election on June 4.

CORCORAN, CAL.—It is understood the San Joaquin Valley Light & Power Company is to spend $80,000 in building a substation six miles south of Alpaugh as soon as the materials can be assembled.

KERMAN, CAL.—The Kerman Telephone Company has announced its intention of building fifty miles of new telephone lines. The work is to begin at once.

LIVINGSTON, CAL.—Plans are under way here for the formation of a lighting district in order to secure an electric lighting system for this locality.

LOS ANGELES, CAL.—Bids are being received by the Board of Supervisors for the installation of ornamental lighting posts in Fifty-fifth Avenue between Budlong and Normandie Avenues.

OAKLAND, CAL.—The Oakland, Antioch & Eastern Railway Company has filed an application with the State Railroad Commission for authority to renew promissory notes for a total of $400,000.

PLACERVILLE, CAL.—Through applications filed with the State Water Commission to utilize water in the Twin Lakes and Echo Lake districts and to build dams and power houses, plans of the Western States Gas & Electric Company to expend over $1,000,000 in power development in El Dorado County have been revealed. Surveying crews are already in the field along the South Fork of the American River, where additional power developments will take place. According to the present plans, one of the dams will be located on Medley Lake in Desolation Valley. Much of the country is without roads and plans are being worked out to pack cement and other building material on mules. The other dam will be at Twin Lakes. A tunnel 2,500 feet long will be constructed under Echo Lake. The work will be under the supervision of Samuel Kahn, manager of the Western States Gas & Electric Company's Stockton headquarters.

PORTOLA, CAL.—R. B. Young, who owns the Grizzly Electric Company in Plumas County, has filed a protest with the State Railroad Commission against the granting to the Great Western Power Company by the Commission of a permit to operate in the same territory.

REDDING, CAL.—F. G. Baum, chief engineer of the Pacific Gas & Electric Company, and Grover Green, resident engineer, left here a few days ago for the Big Bend of the Pit River to begin at once surveys and prepare details for the company's power project, on which $17,500,000 is to be spent. Roads are being repaired so heavy hauling may be done expeditiously from Bella Vista by way of Ingot and Montgomery Creek to Henderson.

SACRAMENTO, CAL.—Governor Stephens has signed a bill making an appropriation for the Folsom power plant.

SACRAMENTO, CAL.—The Supreme Court of California has sustained the order of the State Railroad Commission establishing all the electric rates to be charged by the San Joaquin Light & Power Corporation, which operates in Kern, Merced, Madera, Fresno, Tulare, Kings and Mariposa Counties.

SALINAS, CAL.—The City Engineer has been instructed to prepare plans and specifications for the proposed electrolier lighting system.

SAN FRANCISCO, CAL.—The Board of Public Works is receiving bids for furnishing and installing lighting fixtures in the Pathological Building, situated on the San Francisco Hospital site.

VISALIA, CAL.—The Railroad Commission has granted the Visalia Electric Railroad Company permission to construct its tracks at grade across three public highways in Tulare County.

INCORPORATIONS

INDIANAPOLIS, IND.—The Electric Controller Company has increased its capital stock from $40,000 to $250,000.

SPRINGFIELD, O.—The United Telegraph & Cable Company has increased its capital stock from $3,000 to $100,000.

PHILADELPHIA, PA.—The American Insulation Company. Capital, $100,000. B. T. Conwell, Jr., principal incorporator.

CHICAGO, ILL.—Chester Johnson Electric Company. Capital, $10,000. Incorporators: C. M. Johnson, E. H. Johnson and W. J. Johnson.

CLEVELAND, O.—Paramount Electric Company. Capital, $5,000. Incorporators: A. E. Fromholz, H. L. Castle, Benjamin Stern and others.

BOSTON, MASS.—Portable Electric Searchlight Company. Capital, $40,000. Incorporators: N. B. Kneass Brooks, F. M. Lawrence and D. E. Hall.

ROCKFORD, MICH.—Hubbel Electric Company. Capital, $15,000. Manufacture and deal in electrical apparatus. Incorporators: H. L. Hubbel, J. J. Waterson and J. R. Gale.

NEWARK, N. J.—The Nitrogen Electric Company. Capital, $15,000. To manufacture electric lamps. Incorporators: Albert F. Jacques, E. A. Eppstein and Rudolph H. Amberg.

LAFAYETTE, IND.—Mills Electric Company. Capital, $100,000. Manufacture electrical accessories for automobiles. Incorporators: Byron J. Mills, Herbert A. Keller and Edwin L. Lewis.

LOS ANGELES, CAL.—Commercial Electrolytic Corporation of California. Capital, $100,000. Incorporators: John McWilliams, F. E. Stevens, R. T. Laughlin, E. F. Wehrle and J. R. Mason.

BALTIMORE, MD.—Henry E. Kries & Sons Company. Capital, $50,000. Manufacture heating, electrical and ventilating apparatus. Incorporators: Henry A. Kries, Henry A. Kries, Jr., and Clarence A. Kries.

NEW YORK, N. Y.—Rock Products Equipment Corporation. Capital, $10,000. Manufacture machinery, engines, dynamos, etc. Incorporators: H. F. Holly, H. F. Gurdes and N. E. Benjamin, 56 Liberty Street.

NEW YORK, N. Y.—The Essankay Electric & Novelty Company. Capital, $10,000. To manufacture electric novelties. Incorporators: J. S. Cuming, M. F. Slupsky and H. Knoch, 540 West 112th Street, New York.

NEW PUBLICATIONS

THIRD-TRACKING THE NEW YORK ELEVATED RAILWAY.—The Interborough Rapid Transit Company, of New York City, has prepared a booklet entitled "How a Twenty-Million-Dollar Railroad Was Built in Mid-Air." It gives an account of the work of third-tracking its system, which was completed in 21 months at a cost of over $20,000,000, and which was done without loss of life of a single passenger and without any serious interruption to traffic.

REPORT ON POWER AND LIGHTING PROBLEMS FOR RIVER FOREST, ILL.—John T. Muir, president of the Village Board of River Forest, Ill., has prepared a report covering points in connection with securing lower rates for electrical energy for operating the village's pumping plant and street-lighting system. Albert A. Radtke, of Chicago, has been retained as consulting engineer for the village, and assisted in conducting the negotiations.

BOOKLETS ON ELECTRIC FURNACES AND INDUSTRIAL HEATING.—"Industrial Heating as a Central-Station Load" is the latest booklet published by the Society for Electrical Development on selling the idea of doing things electrically. Before publishing this booklet

the whole industrial heating field was carefully analyzed by the engineering staff of the Society. Every fact, every theory, every practical application was looked into, with the view to publishing the very best analysis possible for the benefit of members of the Society and the entire electrical industry. New conditions and the war make this book very timely. Part 1 deals with electric furnaces. Part 2 gives in compact form, for ready reference, facts and data as to various uses and applications of commercial electric heating, which will apply more particularly to the smaller cities. The two books together provide a library on industrial heating.

FINANCIAL NOTES

Northern States Power Company has offered $1,500,000 new seven-per-cent preferred to stockholders at par and accrued dividends. A syndicate has been formed to take any part of the issue not subscribed for by the stockholders.

Frank T. Hulswit, president of the United Light & Railways Company, says the company and its subsidiaries have been affected comparatively little by the increase in cost of fuel and other operating supplies, due to the fact that they they have favorable long-time contracts for these materials which were entered into before the present high prices prevailed.

The satisfactory condition of Columbia Gas & Electric Company and its subsidiaries is shown in the marked increase in net income and surplus during April. Gross increased 16.4 per cent, net 14.5 per cent and other income, $122,364, or 314 per cent over 1916. Surplus charges increased $303,575, or 140.6 per cent over 1916. For the four months ended April 30 the company showed surplus after charges of $1,479,575, or at the annual rate of 8.87 per cent on the $50,000,000 capital stock, as compared with 2.31 per cent earned in 1916. For the full year 1916 operating ratio stood at 51 per cent, while for the four months ended with April this was reduced to 45.5 per cent.

It is understood that business of the Montana Power Company has increased to a basis indicating gross for the year of between $7,000,000 and $8,000,000, as compared with $6,200,000 for 1916. The company conducts its business with a force of about 100 employes, excepting members of whatever construction gangs may be at work in extending the Montana Power service. Thus the agitation quite prevalent at this time among public utilities of the East for higher rates to meet growing expenditures of operation does not affect the Montana company with its excellent source of power supply. This year the company will have placed in operation a substantial increase to its facilities through addition of about 50,000 horsepower. The chief addition will be at Holter, 30 miles north of Helena on the Missouri River. Last year there was spent on this development $1,300,000, to finish which it is estimated that $1,500,000 will be required. Another installation to cost $500,000 will be shortly available at the Rainbow plant of the company.

The annual report of the Washington Railway & Electric Company for the year ended December 31, 1916, shows the largest gross earnings in the history of the company, they being $5,539,465, compared with $5,191,627 for 1915. According to the report, the outlook for earnings in 1917 is favorable. This estimate is based on the fact that the present condition of war will require a large increase in the number of government employees, due to the new bureaus and commissions, which will result in a greater number of people requiring transportation and electric service. After paying five per cent on the preferred stock, the company had a surplus available for the $6,500,000 common stock of $567,453, or 8.73 per cent on that issue. During the year the company spent $823,835 for extensions, equipment, additions and plant betterments, making a total of $6,741,793 expended on these items in the past ten years. There was also $955,161 charged to the maintenance and depreciation item in 1916.

A committee has been formed by directors of Cities Service Company to sound the sentiment among stockholders of the company in regard to the proposed reduction in the par value of the common stock. Those on the committee are Warren W. Foster, F. W. Frueauff and Frank S. Terry. The results of their investigation will be presented at the directors' meeting to be held on June 20. The plan generally considered involves the exchange of the stock on a ten-to-one basis, making the par value $10, though there are some who suggest making it $25. On the $10 par basis the stock on the present selling price would have a value of about $28 a share and on the $25 par value basis about $70. At the same time the committee is also considering the advisability of listing the stock on the New York Stock Exchange. It is generally believed that this will be done. There is considerable trading in Cities Service shares and with the reduction in the par it is expected that a wider market will be made for the stocks. On completion of the new 12,500-kilowatt unit for its electric station at Riverton, Kan., the total generating capacity of the Empire District Electric Company, a subsidiary of Cities Service Company, will be 47,500 kilowatts.

Reports of Earnings.

NEW ORLEANS RAILWAY & LIGHT.

New Orleans Railway & Light Company, a subsidiary of American Cities Company, controlled by United Gas & Electric Corporation, reports earnings for the three months ended March 31, as follows:

	1917.	1916.
Gross earnings	$1,989,000	$1,835,159
Net after taxes	747,520	724,393
Balance after deductions and charges	591,477	562,225
Net income after interest	273,110	261,577
Surplus after renewals and depreciation reserves	*221,441	203,474

*This amount previous to distribution, as dividends is subject to a further deduction of $16,666 a month, beginning June 1, 1916, and ending June 1, 1918, as an additional reserve for repairs, maintenance, renewals and replacements.

DUQUESNE LIGHT.

Earnings of Duquesne Light Company and subsidiaries for the fiscal year ended March 31, 1917, compare as follows:

	1917.	1916.
Total earnings	$7,310,704	$5,368,025
Net	2,990,261	2,695,151
Other income	112,245	224,386
Charges, rents, etc.	573,207	727,803
Balance	2,529,298	2,191,734
Improvements, betterments and depreciation	360,971	577,247
Surplus	2,168,327	1,614,487

COLUMBIA GAS & ELECTRIC.

	1917.	1916.
April gross	$ 917,782	$ 787,924
Net	489,553	427,405
Total income	651,738	467,326
Surplus after charges.	303,575	126,134
Four months' gross	4,082,813	3,477,541
Net	2,218,414	1,886,497
Total income	2,862,147	2,039,931
Surplus after charges.	1,479,575	690,252

DETROIT EDISON.

The Detroit Edison Company reports earnings for April and four months ended April 30, as follows:

	1917.	1916.
April gross	$ 977,688	$ 775,855
Net	303,160	290,198
Surplus after charges.	218,426	204,029
Four months' gross	4,166,104	3,371,656
Net	1,457,471	1,370,614

VIRGINIA RAILWAY & POWER.

Virginia Railway & Power Company reports of earnings for April and 10 months ended April 30 compares as follows:

	1917.	1916.
April gross	$ 506,072	$ 475,700
Net from operation	261,176	252,726
Net before depreciation	115,421	113,092
Ten months' gross	5,003,468	4,682,348
Net from operation	2,588,432	2,491,377
Net before depreciation	1,155,287	1,121,486

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRIC COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate per cent.	Bid May 14.	Bid May 21.
Adirondack Electric Power of Glens Falls, common	..	22	20
Adirondack Electric Power of Glens Falls, preferred	6	75	76
American Gas & Electric of New York, common	10+extra	130	125
American Gas & Electric of New York, preferred	6	49¼	49
American Light & Traction of New York, common	..	309	307
American Light & Traction of New York, preferred	6	110	110
American Power & Light of New York, common	4	70	68
American Power & Light of New York, preferred	6	88½	89
American Public Utilities of Grand Rapids, common	..	34	30
American Public Utilities of Grand Rapids, preferred	6	66	64
American Telephone & Telegraph of New York	..	118¾	120½
American Water Works & Elec. of New York, common	..	7	6½
American Water Works & Elec. of New York, particip.	7	26	25
American Water Works & Elec. of New York, first preferred	..	78	76½
Appalachian Power of Bluefield, common	..	5	5
Appalachian Power of Bluefield, preferred	7	33	33
City Service of New York, common	6+extra	†274	285
City Service of New York, preferred	6	84¼	85
Commonwealth Edison of Chicago	8	124	125
Comm. Power, Railway & Light of Jackson, common	4	51	49
Comm. Power, Railway & Light of Jackson, preferred	6	74	74
Federal Light & Traction of New York, common	..	11½	11
Federal Light & Traction of New York, preferred	..	42	43
Illinois Northern Utilities of Dixon	6	78	78
Middle West Utilities of Chicago, common	2+2 extra	†43	42
Middle West Utilities of Chicago, preferred	6	67	68
Northern States Power of Chicago, common	7	89	88
Northern States Power of Chicago, preferred	7	96	97
Pacific Gas & Electric of San Francisco, common	5	55	55¾
Pacific Gas & Electric of San Francisco, preferred	6	88	88
Public Service of Northern Illinois, Chicago, common	7	92	90
Public Service of Northern Illinois, Chicago, preferred	6	96	95
Republic Railway & Light of Youngstown, common	4	29	29
Republic Railway & Light of Youngstown, preferred	6	64	64
Standard Gas & Electric of Chicago, common	..	11	10
Standard Gas & Electric of Chicago, preferred	6	35	35
Tennessee Railway, Light & Power of Chattanooga, common	..	5¼	5¼
Tennessee Railway, Light & Power of Chattanooga, preferred	6	26	24½
United Light & Railways of Grand Rapids, common	4	40	39
United Light & Railways of Grand Rapids, preferred	6	68	68
Western Power of San Francisco, common	..	13	13
Western Power of San Francisco, preferred	6	52	51
Western Union Telegraph of New York	5+extra	91½	92
Industrials—			
Electric Storage Battery of Philadelphia, common	4	59	60
General Electric of Schenectady	8	*158	159½
National Carbon of Cleveland, common	8	*75¼	*75
National Carbon of Cleveland, preferred	7	*133	*133
Westinghouse Electric & Mfg. of Pittsburgh, common	5+extra	48¼	54¾
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	*64	67

* Last sale. † Ex-dividend.

UTAH SECURITIES SUBSIDIARIES.

	1917.	1916.
April gross	$ 526,223	$ 442,056
Net	296,806	244,695
Twelve months' gross.	5,914,784	5,080,311
Net	3,276,411	2,754,631

ARIZONA POWER AND PRESCOTT GAS & ELECTRIC.

The Arizona Power Company and Prescott Gas & Electric Company have issued a combined statement of income and profit and loss for the years ended December 31, 1916, and 1915, as follows:

	1916.	1915.
Gross operating revenue.	$363,776	$279,280
Operating expenses	135,494	105,194
Net operating revenue...	228,282	174,086
Other income	687	981
Total income	228,969	175,067
Interest on bonds	125,707	125,850
Interest on collateral notes	10,667	.....
Interest—miscellaneous...	4,292	183
Total deductions from income	140,666	126,033
Net income	88,304	49,033
Reserve for depreciation.	22,473	14,557
Reserve for doubtful accounts	1,359	120
Amortization of bond discount	1,272	1,272
Net income, less reserves, etc.	63,200	33,085
Profit and loss—surplus for the year	63,070	33,751
Profit and loss—surplus at beginning of year...	133,059	99,308
Profit and loss—surplus at December 31, 1916...	196,129	133,059

The Arizona Power Company's bills against the Prescott Gas & Electric Company for power, amounting to $15,935.67 in 1916 and $16,002.96 in 1915, have been eliminated.

GENERAL GAS & ELECTRIC.

The comparative operating revenues of the subsidiaries of the General Gas & Electric Company for the month of April, 1917 and 1916, are as follows:

	1917.	1916.
Penna. Utilities Co.	$ 97,518	$ 84,948
Interurban Gas Co.	815	627
Rutland Ry., Lt. & Pr...	35,714	33,063
N. W. Ohio Ry. & Pr.	21,952	21,682
Sandusky Gas & El. Co..	48,877	43,431
Binghamton Lt., Ht. & Pr.	28,967	25,720
Sayre Electric Co.	8,178	7,475
New Jersey Pr. & Lt.	16,455	14,121
Total	258,476	231,067

PACIFIC GAS & ELECTRIC.

March—	1917.	1916.
Gross earnings	$ 39,978	$ 33,677
Operating expenses....	24,254	24,355
Net earnings	15,724	9,323
Other income	60	48
Total income	15,785	9,371
Operating ratio	6.6%	72.4%
Twelve months—		
Gross earnings	$ 413,112	$ 370,727
Operating expenses & taxes	265,786	257,250
Net earnings	147,327	113,476
Other income	1,380	9,639
Total income	148,707	123,115
Bond interest	52,355	51,591
General interest	1,460	2,381
Depreciation	44,805	35,493
Net income	50,087	33,652
Preferred dividend	35,000	35,000
Surplus	15,087	*1,348
Operating ratio	64.1%	69.3%

*Deficit.

PROPOSALS

ENGINE-DRIVEN GENERATORS.—The Passaic Valley Sewerage Commission, 31 Clinton Street, Newark, N. J., will receive bids June 26 for three 50-horsepower engine-driven electric generator sets for the pumping station on the Newark meadows.

ELECTRICAL WORK.—The Board of Education, Hoboken, N. J., will receive bids up to 8 p. m., May 29, for electrical work in the new school to be erected at Adams and Fifth Streets, construction bids being received at the same time. William A. Kerr is secretary.

ELECTRICAL SUPPLIES.—Bids will be received at the Bureau of Supplies and Accounts, United States Navy Department, Washington, D. C., for furnishing supplies at the following naval stations: Schedule 1130, Philadelphia, Pa., one indicating and annunciating system with motor-driven pump. Schedule 1134, various naval stations, miscellaneous electrically-driven deck winches. Schedule 1136, Brooklyn, N. Y., one complete heating and ventilating set and three complete ventilating systems. Schedule 1139, Norfolk, Va., 25 electrolytic generators (oxygen and hydrogen). Schedule 1145, Brooklyn, N. Y., miscellaneous materials for switchboard panels. Bidders desiring to submit proposals should make application to the bureau or to the nearest navy yard purchasing office.

Electrical Patents Issued May 15, 1917

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,225,738 Insulator for High-Tension Conductors. A. Aichels, assignor to Aktiengesellschaft Brown Boveri & Cie., Baden, Switzerland. Sleeve insulator in a socket.

1,225,758. Thermostat. W. H. Bristol and H. Koster, assignors to The Bristol Co., Waterbury, Conn. Details of structure in a measuring instrument.

1,225,786. Car and Electric Coupling. E. H. Dewson and T. R. Brown, assignors to Westinghouse Air Brake Co., Pittsburgh, Pa. Has a fluid-operated movable electrical connector.

1,225,787. Educational Magnetic Toy. A. V. Diehl, Buzzards Bay, Mass. Has magnetically controlled means for simulating the dropping of bombs from aircraft.

1,225,796. Automatic Fog Safety Ship's Guide. O. Fricke, New York, N. Y. Record is produced on a chart by coincidently sent audible signal and electrical impulse from shore station to ship.

1,225,798. Method of Producing Smoke for Curing Meats. R. J. Gaudy, Detroit, Mich. Smoke-producing material is electrically heated.

1,225,820. Electric Switch. C. F. Kettering and E. S. DeMaree, assignors to Dayton Engineering Laboratories Co., Dayton, O. Structural details of longitudinally reciprocating device.

1,225,826. Electrical Heating Unit. F. Kuhn and F. E. Shailor, assignors to American Electrical Heater Co., Detroit, Mich. Conical coils are mounted on conical insulators supported in plate.

1,225,827. Electrical Heating Unit. F. Kuhn and F. E. Shailor, assignors to American Electrical Heater Co. Manner of mounting on bottom of pan.

1,225,850. Refrigerating Apparatus. J. M. Peterson, assignor to G. J. Sayer, Chicago, Ill. Compressor motor is controlled by thermostat.

1,225,852. Rectifier. G. W. Pickard, assignor to Wireless Specialty Co., New York, N. Y. Oscillation detector comprising a rectifying conductor.

1,225,860. Electric Control System. F. Rieber, assignor to Rieber Laboratories, San Francisco, Cal. Lamp for lighting room in primary of transformer is short-circuited to operate X-ray tube in secondary.

1,225,865. Electrical Advertising Device. F. Schneible, assignor to C. A. Schneible, Inc., New York, N. Y. For mounting on faucet for dispensing liquids.

1,225,888. Automatic Controller. F. T. Taylor, Boston, Mass. Power may be cut off by either of two controllers, which are interlocked so that both must be operated to renew the supply of power.

1,225,890. Fuse Plug. H. V. Thomas, assignor to Killark Electric Mfg. Co., St. Louis, Mo. Has combined socket-engaging and window-retaining member.

1,225,901. High-Tension Switch. E. Weissberg, Cassel, Germany. Gaseous pressure is supplied to plunger to operate switch and to switch-box to extinguish arc.

1,225,926. Trolley Harp. J. H. Carmack, Denison, Tex. Structural details.

1,225,934. Fire-Alarm System. D. G. Dee, assignor to R. H. Rogers, Rochester, N. Y. For magneto telephone lines.

1,225,935. Fire-Alarm Telephone Transmitting Mechanism. D. G. Dee, assignor to H. Rogers, Rochester, N. Y. Has special arrangement of trouble-alarm system.

1,225,936. Fire-Alarm Trunk-Switching Mechanism. D. G. Dee, assignor to R. H. Rogers. Details of exchange arrangement.

1,225,937. Factory Fire-Drill System. D. G. Dee, assignor to R. H. Rogers. Reduction of voltage of normally energized circuit cuts out resistance and operates alarm mechanism.

1,225,940. Alarm Device. L. P. Dixon, New York, N. Y. Pneumatic horn electrically operated from push button and by hand bulb to produce uniform note.

1,225,943. Switchboard Cord-Circuits for Fire-Alarm Telephone Systems. J. Erickson, assignor to R. H. Rogers, Rochester, N. Y. Comprises special alarm impulse transmitting mechanism.

1,225,962. Safety Device. F. Hymanns, assignor to Otis Elevator Co., Jersey City, N. J. Elevator brake is speed-controlled electromechanically.

1,225,963. Motor-Control Apparatus. F. Hymanns, assignor to Otis Elevator Co. Pilot-motor control of induction motor driving elevator.

1,225,975. Mercury Motor-Meter. R. C. Lanphier, assignor to Sangamo Electric Co., Springfield, Ill. Special structure and arrangement of magnets.

1,225,976. Elevator-Control System. D. Larson, assignor to Otis Elevator Co., Jersey City, N. J. Push-button control on a polyphase supply circuit.

1,225,992. Turbogenerator for Ships. R. V. Morris, Inc., Ithaca, N. Y. Details of gyroscopic mounting.

1,226,009. Burglar Alarm. C. Reiser, Chicago, Ill. Has special arrangement of circuits for testing purposes.

1,226,017. Inclosed Fuse. G. A. Schaefer, assignor of one-half to F. W. Irving, Chicago, Ill. Relates to manner of securing fuse-link to end-caps.

1,226,031. Electric Switchboard. C. A. Vendervell and A. H. Midgly, Acton Vale, London, England. For use with electric systems of motor vehicles.

1,226,056. Electrical Measuring Instrument. W. M. Bradshaw and W. G. Mylius, assignors to Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. Structure of magnet for acting on rotary disk, having adjustably mounted closed-circuit conductors about certain of the limbs.

1,226,058. Electrically Controlled Calculating Machine. J. W. Bryce, Bloomfield, N. J. Elapsed-time calculating machine electrically controlled by punched time cards.

1,226,060. Receiver of Electrical Oscillations. E. E. Butcher, Interlaken, N. J., assignor to Marconi Wireless Telegraph Co. Comprises an aerial grounded at one end and having a detector connected to the opposite end.

1,226,067. Auxiliary Apparatus for Vapor Converters. E. E. Eby, assignor to Westinghouse Electric & Mfg. Co. Has a solenoid which operates a valve for an exhausting tube and also a movable electrode.

1,226,069. Anode Structure for Vapor Converters. S. W. Farnsworth, assignor to Westinghouse Electric & Mfg. Co. Comprises a loop of tubing through which temperature-regulating fluid circulates, and carrying a mass of arc-supporting material.

1,226,076. Revolving Fan. O. S. Jennings, assignor to Westinghouse Electric & Mfg. Co. Structure of rotatable support upon which pivotal electric fans are moved in one direction by gravity and in oteher by centrifugal force.

1,226,083. Ignition Device for Internal-Combustion Engines. G. A. Krohn, Coarsegold, Cal. Structure of timer.

1,226,088. Insulator and Composition Material for Insulating and Other Purposes. F. M. Locke, Victor, N. Y. Formed by fusing silica, boron and fluorin materials.

1,226,091. Alternating-Current Induction Motor. B. McCullom, Washington, D. C. Concerns relation of primary and secondary windings and magnetic circuits therethrough.

1,226,099. Transmitting Apparatus for Use in Wireless Telegraphy and Telephony. G. Marconi, assignor to Marconi Wireless Telegraph Co., New York, N. Y. A series of exciting circuits are successively charged and discharged for maintaining continuous oscillations in an oscillating circuit.

1,226,102. Direction Indicator and Signaling Device for Vehicles. R. F. Medicus, Youngstown, O. Structure and arrangement of casing, lights, solenoid-operated indicator arms, license-plate holder, etc.

1,226,114. Circuit-Interrupter. A. C. Randall, assignor to Westinghouse Electric & Mfg. Co. Gas generated at contacts in an air-tight casing is supplied to operating mechanism.

1,226,121. Manufacture of Electrodes. A. P. Scott, assignor to Chile Exploration Co., New York, N. Y. Method of casting hollow magnetite electrodes.

1,226,122. Electric Furnace and Method of Producing Molten Magnetite Therein. A. P. Scott, assignor to Chile Exploration Co., New York, N. Y. Single-phase, direct-arc type.

1,226,126. System of Distribution and Control for Electric Railways. K. A. Simmon, assignor to Westinghouse Electric & Mfg. Co. Alternating direct-current system.

1,226,130. Brush for Electric Machinery. E. M. Soreng, assignor to Allis Chalmers Mfg. Co., Milwaukee, Wis. Of metal fabric with a backing of solder.

1,226,142. Voltage Regulating System. N. W. Storer, assignor to Westinghouse Electric & Mfg. Co. Fluid-operated, resistance-controlling mechanism has valves electromagnetically controlled by circuit conditions.

1,226,151. Refillable Cartridge Fuse. L. E. Weinberg, assignor to Star Fuse Co., New York, N. Y. Has a glass casing.

1,226,152. Shooting. C. Weslow, Jersey City, N. J. In a game, a tube for projecting a magnetic ball has a magnet at one end for retrieving it.

1,226,157. Combined Telephone and Signaling System. C. S. Winston, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Comprises means for transmitting and receiving code calls.

1,226,161. Connector. S. Anthony, Boston, Mass. Structure for mechanically and electrically connecting conductors.

1,226,166. Receiver Support for Telephones. B. Badanes, New York, N. Y. For supporting the receiver in listening position.

1,226,184. Electrical Selector. L. C. Bygrave, assignor to Relay Automatic Telephone Co., London, England. Arrangement of a series of impulse-operated switching relays.

1,226,193. Switch Connection for Electric Lamps. C. L. DeMartin, assignor to Indiana Lamp Co., Connersville, Ind. For use in a headlight.

1,226,211. Lighting Fixture. M. Herskovitz, assignor to Peerless Light Co., Chicago, Ill. Details of member for supporting lights from ceiling and providing conduit for conductors.

1,226,233. Ignition Dynamo. C. T. Mason, assignor to Splitdorf Electrical Co., Newark, N. J. System of generation and distribution of ignition current from a trunk point to a number of spark devices in a determinate order.

1,226,234. Distributer for Ignition Devices. C. T. Mason, assignor to Splitdorf Electrical Co., Newark, N. J. Structural details.

1,226,255. Motor-Controlling Device. J. Richmond, assignor to American Laundry Machine Co., Cincinnati, O. For intermittently reversing the motor; for use with washing machines.

1,226,264. Electric Furnace. F. C. Schmitz, New York, N. Y. Details of structure with water cooling.

1,226,279. Process of Eliminating and Recovering Acids or Metallic Salts. H. F. Tiffany, assignor to Continental Fibre Co., Newark, Del. Metallic Salts or Acids used in hardening fibre are removed therefrom by electrolysis.

1,226,290. Storage Battery. T. A. Willard, assignor to Willard Storage Battery Co., Cleveland, O. Structure of cover.

1,226,294. Automobile Lamp. F. E. Wolcott, Hartford, Conn. Structure of headlight.

1,226,309. Brush-Holder. R. G. Clark, New York, N. Y. For brushes of dynamo electric machines.

1,226,319. Oil Vaporizer for Explosive Engines. C. W. Dyer, Stratton, Me. Electrically heated.

1,226,325. Projecting Lamp. H. W. Germanos, Boston, Mass. Structure of reflectors.

1,226,338. Lamp-Socket. H. R. Land, Little Rock, Ark. Has a pin engaging lamp-base to prevent unscrewing.

1,226,350. Mechanism for Welding Pipe by Electricity. C. Mark and C. O. Bergman, Evanston, Ill., assignors to Clayton Mark, Lake Forest, Ill. For welding edges of blank by resistance process to form longitudinal seam.

1,226,383. X-Ray Tube. W. Robinson, West Lynn, Mass. Has no metallic parts in the vacuum; electrodes are outside at one end and one side with window in other end.

1,226,389. Transmitter Cutout Device. P. O. Schulz, Boyd, Minn. For telephone instruments; is operated by receiver hook.

1,226,399. Spark-Plug. J. J. Smith, Benton Harbor, Mich. Structural details.

1,226,404. Switch. A. K. Sutherland, assignor to Trumbell Electric Mfg. Co., Plainville, Conn. Two-push-button, flush.

1,226,406. Alternating-Current Synchronizing Motor. R. W. Swift, assignor to Peerless Electric Co., Warren, O. Induction motor has one member with definite number of poles, and other member with winding having two paths, one producing symmetric and other unsymmetric poles with relation to poles of other member.

1,226,433. Current Tap. W. R. Young, assignor to Bryant Electric Co., Bridgeport, Conn. Comprises a jack and jack-receiving terminals.

1,226,451. Electric Controlling and Feeding Apparatus. S. B. Blakely, Chicago, Ill. For arc-light carbons.

1,226,470 and 1,226,471. Refractory Metal Tube. W. D. Coolidge, assignor to General Electric Co., Schenectady, N. Y. Resistance element for an electric furnace, consisting of a tubular homogeneous mass of tungsten with copper terminals autogenously united to the ends, and method of making.

1,226,491. Electric Meter. A. J. R. Fiego, assignor to General Electric Co. Adjustable gearing of motor meter.

1,226,501. Trolley Wheel. E. Gabriel, Athens, O. Structure of mounting and guards.

1,226,534. Electric-Load Distributer. J. E. King, assignor of one-half to W. C. Pearce, Syracuse, N. Y. Prime mover of generator operating in conjunction with main source of supply is controlled by motor responsive to power delivered by the main source.

1,226,546. Automatic Motor-Controller. L. J. McDowell, assignor to Wheeler McDowell Elevator Co., New York, N. Y. Resistance contacts in a chamber are successively short-circuited by a fluid forced therein by a solenoid and automatically controlled by a special check valve.

1,226,550. Illuminated Sign. C. A. McNeal, Columbus, O. Structure of device having a lamp and reflectors set in the outline of a letter or design.

1,226,558. Electric-Lamp Holder. C. Martinez, Habana, Cuba. Structure of fused socket.

1,226,584. Cutout. H. T. Paiste, assignor to H. T. Paiste Co., Philadelphia, Pa. Details of socket shell and terminals.

1,226,587. Motive-Force Control for Apparatus. S. J. Paul, Los Angeles, Cal. Structure and operating means for motor-circuit limit switch.

1,226,607. Phonograph Lamp. P. Gillen, assignor to Hudson Brass Works, Brooklyn, N. Y. Unit comprising lamp and dry batteries for mounting in phonograph casing.

1,226,617. Electromagnet. F. B. Parker, Chicago, Ill. Structure of device having two armatures attracted by different magnetic strengths.

1,226,619. Electrical Safety Device for Railroads. G. E. Charron, Ottawa, Ontario, Canada. Signal for indicating displacement of rails at a joint.

14,302. Controlling Apparatus for Railway Switches and Signals. H. W. Griffin, assignor to Union Switch & Signal Co., Swissvale, Pa. Original No. 1,033,243. Dated July 23, 1912. Details of apparatus for controlling a traffic signal by the position of a track switch capable of normal and reverse positions.

PATENTS EXPIRED.

The following United States electrical patents expired on May 22, 1917:

649,922. Apparatus for Electrically Lighting Lamps. H. C. Farquharson. New York, N. Y.

649,927. Rheostat. C. Flohr, Berlin, and R. Dietze, Coswig, Germany.

649,933. Electric Releasing-Device for Shutters. J. Hueston, New York, N. Y.

649,936. Coin-Freed Liquid-Vending Apparatus. Richard Kann, Jena, Germany.

649,942. Synchronizer for Electric Machines. C. J. A. Michalke, Charlottenburg, Germany.

649,950. Battery Plate. J. K. Pumpelly, Chicago, Ill.

649,959. Signal for Trunk Lines of Telephone Systems. C. E. Scribner, Chicago, Ill.

649,972. Electric Motor-Controlling Device. T. S. Watson, Milwaukee, Wis.

649,974. Dynamo Engine. M. L. Whitfield, Memphis, Tenn.

649,976. Electric Incandescent Lamp. J. Atherton, London, England.

649,989. System of Electrical Distribution for Electric Railways. F. R. Koss, Charlottenburg, Germany.

649,990. Underground Electric-Railway System. J. B. Larkin, Pittsburgh, Pa.

649,994. Automatic Circuit-Closing Telegraph Key. L. F. Ritchie, Elwyn, Pa.

649,998. Element for Storage Batteries. E. A. Sperry, Cleveland, Ohio.

650,010. Electric Switch. J. B. Heller, Philadelphia, Pa.

650,014. Electric Motorcycle. I. Kitsee, Philadelphia, Pa.

650,015. Electric Welding. E. Lagrange and P. Hoho, Brussels, Belgium.

650,030. Apparatus for Operating Contacts for Electric Traction. A. Ballance and S. A. Jefferson, Hull, England.

650,051. Electroplating Apparatus. L. Potthoff, New York, N. Y.

650,057. Controller for Electric Circuits. A. L. Waters, San Francisco, Cal.

650,062. Thermoelectric Pile. L. Gottscho, Charlottenburg, Germany.

650,090. Electrical Ear Trumpet. F. Macdaniel, New York, N. Y.

650,094. Track and Conduit Construction for Underground Electric Street Railways. J. H. Robertson, New York, N. Y.

650,096. Recorder for Rapid Automatic Telegraphy. C. F. Rodde, Berlin, Germany.

650,109 and 650,110. Apparatus Employed in Wireless Telegraphy. G. Marconi, London, England.

650,113. Insulating Coupling. L. McCarthy, Boston, Mass.

650,115. Insulating Coupling for Electric-Wire Conduits. G. W. Prouty, Littleton, Mass.

650,119. Electrical Switch. E. J. Wade, London, England.

650,123. Contact Device for Electric Railways. W. M. Brown, Johnstown, Pa.

650,124. Electrical Metal-Working Apparatus. C. Coleman, Chicago, Ill.

650,141. Static-Induction Generator. R. V. Wagner, Chicago, Ill.

650,172. Telegraphic Sounder. A. A. Dittmar, Jersey City, N. J.

650,178. Manufacture of Filaments for Incandescent Electric Lights. S. B. Husselman, Worcester, Mass.

650,196. Switch for Electric Motors. G. A. Schoeller, Mulheim-on-the-Ruhr, Germany.

650,219. Storage Cell. F. W. Barhoff, Hartford, Conn.

650,246. Armature for Dynamoelectric Machines. G. Heidel, St. Louis, Mo.

650,247. Electrode for Secondary Batteries. F. Heimel, Vienna, Austria-Hungary.

650,255. Space Telegraphy. I. Kitsee, Philadelphia, Pa.